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ABSTRACT

The Randolph, New Jersey Intermediate School updated its industrial arts program to reflect the challenges and work force of the Twentieth Century in which students apply a design/problem-solving process to solve real-world problems. In the laboratory portion of the program, students circulate between workstations to define problems, complete research, develop solutions, build models, and evaluate their effectiveness. The first of three documents, "Program Description," describes that program in four parts. Part 1 provides a program description that discusses characteristics of the student population involved in the program; teacher and student materials developed for the program; and a history of the development of the program. Part 2 presents the goals of the four laboratory stations and a course of study. The four workstations are: (1) designing with structures; (2) control systems technology; (3) transportation modeling; and (4) computer graphic presentation. The course of study includes a statement of emphasis; a list of 18 course objectives; suggested time allotments per course unit; and an outline of course content by topic. Part 3 discusses research support for the course and a list of 15 references. Part 4 reports the program evaluation of the six criteria established for the program. Findings indicated that student learning was active; workstations were effective; project criteria were met; students portfolios were effective for individualized learning; and the course was cost-effective. A summary of Program Description Book 1 is provided. The second of three documents, "Teacher Materials," provides teacher materials for the implementation of the program. The materials are presented in six sections. The first section describes workstation activity use. The second section discusses teaching methodology that employs technological problem solving. The third section presents four technology learning modules involving: (1) vehicle and flight design; (2) structure modeling; (3) robotics/control technology; and (4) computer graphics. Each module includes a list of the primary concepts involved; a list of activities; performance objectives; needed vocabulary; integrated subjects; equipment needed; and a list of resources and references. The fourth section discusses workstation implementation strategies. The fifth section describes the technology laboratory environment. The sixth section discusses student evaluation techniques. The last of three documents, "Student Information," describes the workstation activities that the students can complete. The material is presented in five sections according to the different workstations: (1) vehicle transportation; (2) structure modeling; (3) lego-logo robotics; (4) computer graphics; and (5) flight modeling. Each section includes objectives to be completed at the workstation; a list of possible activities; and the design/problem solving process steps necessary to complete the activities. A series of worksheets to be completed by the student while performing workstation activities is provided. (MDW)

SE

TEACHER DEVELOPED TECHNOLOGY

TD - TEN

EDUCATION FOR THE NINETIES

PROGRAM DESCRIPTION

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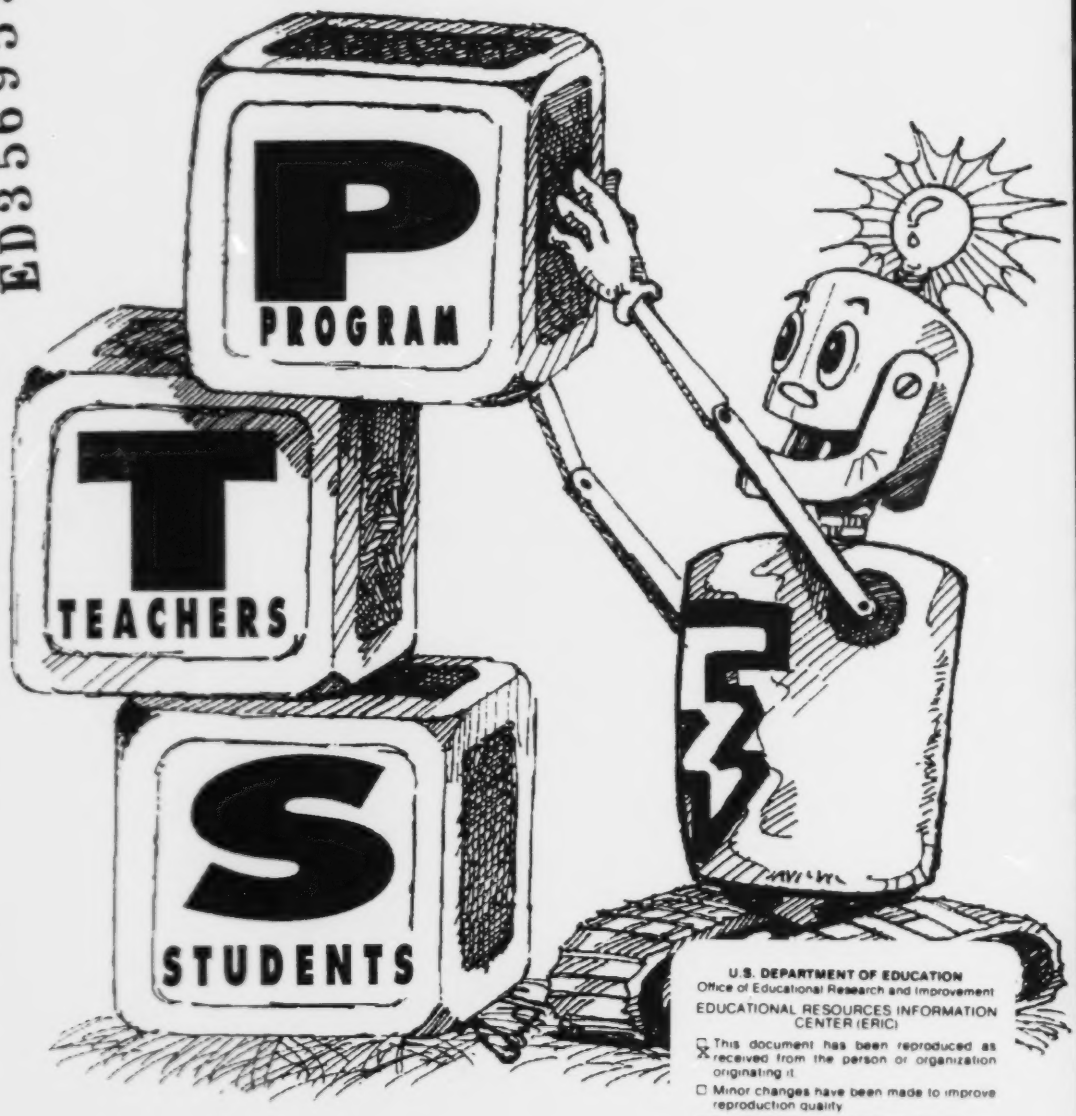

PROBLEM SOLVING with WORKSTATIONS

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PROBLEM SOLVING with WORKSTATIONS

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SUMMARY

This project was conducted pursuant to a contract from the New Jersey State Department of Education, Division of Vocational Education and was 100% state funded under the State Income Tax Revenue Account. Monies in this account are appropriated through New Jersey Statutes Annotated, Subtitle 7, State and Federal Aid to Schools, Section 18A:58-34 and 35. The contractors undertaking this project were encouraged to express their judgement in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official funding agency positions or policies.

PROBLEM SOLVING with WORKSTATIONS

An Approach to Technology Education in the Middle School

by

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PROGRAM DESCRIPTION

PROBLEM SOLVING WORKSTATIONS

Introduction

Randolph Intermediate School has gone high-tech with its Introduction to Technology program for the seventh and eighth grade students. During the past five years, we have modified and updated our industrial arts program to reflect the challenges and work force beyond the Twentieth Century. Students apply a design/problem solving process to solve problems relating to the world of technology. Students define problems, complete research, develop solutions, build models, test and evaluate their effectiveness.

This program accurately simulated the technologically impacted work place where computers are used to solve problems and team efforts draw expertise from a number of different disciplines. In the Lab students work at interdisciplinary laboratory stations applying principles of science, math, art and language arts to such vital subject areas as computer design and graphics, control/robotics technology, structure design and testing, and transportation modeling. Work stations form a series of activity zones where students work, interact, and learn. Each station is designed to incorporate all of the services, equipment and instructional materials to accommodate four to six students.

As one moves from station to station, you will see a variety of activities that engross each student. Though students start out experiencing a narrow band of learning activities, they are soon handling thematic projects that cause them to interact with other teams at different stations. the students are developing the ability to work in teams as they share and learn to be tolerant of the perspectives of others. Students complete research and explore solutions on their own using the class resource center, library or the computer. They use various materials to model real world solutions. Balsa wood structures support calculated loads, Lego building blocks are controlled with motors and sensors, then interfaced to the computer and operated by Lego computer programs. Cars and glider are designed and tested on the computer then built and tested. Graphics and desk top publishing is accomplished on Apple computers and used to accompany various classroom activities.

One of the wonderful experiences practiced and learned in the modular arrangement is that of project management - the ability to make a complex event happen. My job is to give students opportunities to explore - chances to use computer simulations, build prototypes of future designs, assemble models and analyze processes and products - recreating in the lab surrounding the fascinating world of technology.

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BASICS

Grade level and/or class subject :
Grades 7 and 8, Introduction to Technology

Number of students enrolled:
Each year half of the 7th grade and half of the 8th grade are enrolled — approximately 310 students.

Hours per week of instruction:
42 min., 5 days a week = 3.5 hrs.

Weeks per school year:
Each enrolled student has 9 weeks of this course as part of the required elective cycle.

The characteristics of the student population receiving this instruction during the 1989-1990 school year.

The student population contains a mix of all students attending our school. Students are required to take Introduction to Technology for nine weeks in either the 7th grade or the 8th grade. The classes contain a mix of male and female students from 11 to 14 years old. Students are grouped homogeneously with a variety of academic levels ranging from gifted and talented to mainstreamed classified students.

This is a first-time exploration of technology with little to no experience unless the student has been exposed at home due to parental interest or occupation. Students do have interests in technology-related topics and are eager to participate in the lab activities. They have a basic understanding of computers beyond word processing or games. Very few students have any tool- and machine-use experience. Most students realize the importance of technology in the world, but understand very little about the historical developments leading to today's advancements or how extensively technology affects their lives. Students at this age are just starting to explore realistic occupational choices and are formulating plans for avenues of study at the high school and beyond. All students have the abilities to complete lab activities and all are excited about the open classroom/work station modular setup we now use.

During the 1990/91 school year students in our Technology program took honors at the SEER (Student Energy Exposition) competition and received the Outstanding Middle-Level School award at the TSA (Technology Student Association) conference/competition. Students also completed interdisciplinary projects and presented them in other classes. Extra curricular activities consist of Technology Student Association (TSA), and Young Astronauts Program.

Enhancements or substantive changes to the implementation of the Technology Education unit/activity in the 1990-1991 school year.

During the 1990-91 school year there have been changes due to the full implementation of the modular approach after last year's partial implementation. Most of the changes pertain to improving the appearance of the work stations and better organization of supplies and materials for each work station. The changes in appearance include replacing makeshift work benches with formica table tops, installing bulletin boards at each station, installing electrical strips

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to replace extension cords, and arranging furniture for maximum work space.

Organizational changes include revising all teaching learning activities (TLA's) and student handouts, organizing a student resource area with a technology information library including books, magazines, videos and computer disks. Supplies were ordered to make student work more productive and efficient such as material organizers and special storage bins.

Teacher and/or student materials which have already been developed or are commercially available.

During the 1986 school year we designed a new course of study using the New Jersey Level 1: Introduction to Technology curriculum as a basis for modifying our course to meet the needs of our students and our scheduling situation. This curriculum has been implemented, evaluated and modified over the past five years. Modules have been revised and implemented including: problem solving with structures, control robotics, computer design, transportation modeling, history of technology and resources and systems of technology. Each module includes activities designed around units of study where students complete technology learning activities (TLA's). The TLA's, student information handouts and teacher lesson guides are developed for each station. Each station has information bulletin boards, samples of student activities and sample student documentation packets, teaching aids including teacher-made and student-made wind tunnel, structure tester, robots, displays and models.

There are many commercially available materials for students and teachers to use in the modular work station approach. One of our most motivational work stations uses Lego robotic materials to learn about control technologies. These Lego robotic devices are supplemented with teacher and student designed electronic sensors and are interfaced with Apple computers where Logo programming software allows students to design devices to be controlled and tested. Students gain a further understanding of robotics by using robotic simulation software and electronic breadboarding materials for prototyping.

Students working at the transportation modeling station explore flight and auto design using computer simulation programs. Students use computer drawing programs to complete simple CAD drawing for their structure designs at the problem solving station using various input devices such as a mouse or touch pad. During activities at the computer graphics module, students use software to complete various graphics such as poster, signs, newsletters, desktop publishing and banners. Various devices are used such as scanners, digitizers, and voice synthesizers to complete multi-media presentations. Our reference area has many books, magazines videos and software that are used extensively in all modules. Various tools and machines are used to aid students in designing and building their models and prototypes.

Each module includes activities designed around units of study where students complete technology learning activities

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History & Development

As I circulate through my technology lab observing, assisting, and questioning students, I am amazed at the progress we have made in just six years in our transition from Industrial Arts to Technology Education.

"In 1985 I started formulating plans for a new program, One which would directly address the need of providing a mechanism to teach young people creative, critical, thinking and problem solving skills."

In 1985 I started formulating plans for a new program, one which would directly address the need of providing a mechanism to teach young people creative, critical thinking and problem solving skills. A new course of study was designed and implemented following model programs from Wisconsin and New York. The following year we became active in piloting the New Jersey Level 1: Introduction to Technology Curriculum. The implementation resulted in students bubbling with excitement as they were challenged with learning which reflected the world around them today and possibilities for the future. I quickly noted that students were eagerly grasping for more knowledge and often their search went beyond my own expertise and expectations. We revised the Commission's curriculum adding new units to further satisfy the students thirst for knowledge. Our program was soon recognized as a leader in the state and was named a model Technology program. We were asked to open our doors to visitors from around the world and were happy to share our experiences, successes and revisions with educators from New Jersey, other states, Australia and the U.K. The Technology Education Association of New Jersey named me their 1989-90 Technology Teacher of the Year and I've been active in workshop presentation to not only teachers interested in developing a Technology Education program, but teachers in other disciplines who would like to incorporate some of our broad skills, such as problem solving and critical thinking, to their courses.

We are helping students learn how to learn for a lifetime

Last year I took the next step in the natural progression of Technology Education's evolution — self-directed activity modules. The idea is based on a self-directed, self-paced instructional system, placing the responsibility for learning directly on each student. Each module contains self-directed activities where students define problems, complete research, develop solutions, build models and evaluate results as they relate to each station. This problem solving approach is the overriding theme which links all modules together. Students work individually, in teams of two or as a team member in a larger group to complete various activities. Each station takes a holistic view of education as

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students study historical artifacts for problems presented, research information, employ scientific and mathematical principles and document results and impacts upon society. For many students it is the first time they see an application for the categorized information they learn in other subject areas, particularly science, math, language arts and history. As we know, all people learn at different rates. This approach fosters student flexibility and understanding.

During the first part of class each day, all students attend mini lessons which pertain to technology concepts related to all the module activities. Concepts such as problem solving methodology, documentation methods, systems of technology, control technology concepts, resources of technology, history and evolution and impacts of technology are broad-based instruction which relate to all areas of technology. Mini lessons are also given at work stations as needed to facilitate student achievement and production. These include instruction on computer program application and use of tools and machines, wind tunnel operation and evaluation, robotic interface operation, and structure assembly procedures. I find myself changing from the role of teacher-instructor to manger-facilitator to guide and help students learn, grow and reach their full potential.

The stations are designed to encourage active exploration and discovery as students perform activities related to the cutting edge of technology. In the module control/robotics technology, students use modular building components to construct models that solve various problems including problems students themselves identify. Students design and build computer controlled, electronically sensored devices that they have researched, developed, programmed and evaluated all on their own. Designs include such activities as laser-activated bridges, programmable plotters, conveyor systems which sort colored blocks, or light activated garage doors.

The stations are designed to encourage active exploration and discovery as students perform activities related to the cutting edge of technology

Students at the modeling station explore transportation by designing cars or gliders on computer simulations and test, modify and evaluate their results. They build prototypes of gliders using balsa wood, then perform stabilization tests in a wind chamber and modify flight characteristics in actual test flights. Other students build clay and wood test cars to evaluate aerodynamics in a wind tunnel. As students rotate to the structures station, they explore different kinds of structures. Following the design problem solving process, they create a structure for load testing or build a replica of a historical structure or design a structure for the future. While developing solutions, students complete sketches, technical drawings and computerized illustrations.

Another station includes computer graphics where students explore designing posters, banners, desktop publishing and multi-media presentations. Students complete documentation for all their work while proceeding through the design loop at each work station. All work, research and findings are recorded in the form of a packet which is self-graded by the student and submitted to the teacher for approval. At the end of the program all students regroup as a class to complete an activity pertaining to the history and evo-

lution of technology. Students work in small groups studying the history of a technological area. they complete research, compile information, make visual aids and build models for a presentation they will make to the class on their chosen topic thus becoming the expert teacher during their presentation.

Yesterday's educational methods and techniques will not equip tomorrow's workers for a rapidly changing world. Society will place new demands on educators for a more integrated and holistic style of education. In an information age, students need to understand concepts and effectively apply their learning rather than merely consume information to regurgitate at a later date. To that end I feel we are helping to produce students who are active learners and who are able to reflect critically on their own learning. we are helping the students learn how to learn for a lifetime.

PART II

Goals for each workstation

DESIGNING WITH STRUCTURES

Goal 1

Focus students learning on the basic concepts, cognitive skills and processes of technological design/problem solving methodology.

Goal 2

Provide the student with the practical experience using the design/problem solving process on technological problems.

Goal 3

Develop basic design and communication skills to document each step of the design/problem solving process.

Goal 4

Involve students in the application of tools, machines, materials, processes and resources of industry and technology.

Goal 5

Gain an understanding of the physics of structures and their importance in technology.

CONTROL/SYSTEMS TECHNOLOGY

Goal 1

Develop an understanding and application of mechanisms and mechanical control.

Goal 2

Develop an understanding of electrical/electronic control as it related to the feedback component of the systems model.

Goal 3

Develop an understanding of the basics of pneumatic and hydraulic principles and how to use them for control.

Goal 4

Develop an understanding of computer control and how everyday technology can be controlled using the closed-loop system of feedback for automation.

Goal 5

Describe the history and evolution of automation and robotics as it relates to control technology.

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TRANSPORTATION MODELING

Goal 1

Develop critical thinking, problem solving, and communication skills.

Goal 2

Engage students in first-hand experiences with technological resources.

Goal 3

Students will understand the relationship of disciplines and the interdisciplinary approach to technology.

Goal 4

Provide students with the knowledge and techniques that are used in technical illustration and the communication of their ideas.

Goal 5

Relate an understanding of the history and evolution of transportation devices.

COMPUTER GRAPHIC PRESENTATION

Goal 1

Solve problems using the tools, machines, processes, products and services of industry and technology.

Goal 2

Progress through a series of distinct steps that are part of the problem-solving process.

Goal 3

Students will identify and describe the history and evolution of the computer as a technological tool.

Goal 4

Define and apply principles and elements of design.

Goal 5

Realize the Various applications of Computers.

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Lessons - Course of Study

I. Statement of Emphasis

Students will be able to understand the importance of keeping pace with technology

Introduction to Technology is designed to bring academic learning from many disciplines into the realm of application by allowing students to creatively apply knowledge to the solution of problems. Basic topics include the evolution of technology, design/problem-solving processes, and the systems approach. Students then explore and combine knowledge in the areas of Structures, Transportation, Computer Graphics, Robotic Control through application of the design/problem solving activities which engage students in hands-on experiences in technology. This course acquaints students with career opportunities in technology and the impact of technology on individuals and society.

III. Course Objectives

Upon completion of the course students will be able to:

1. develop an awareness of technology-related careers.
2. be able to make objective decisions through comparative analysis.
3. identify some of the positive and negative impacts of technology on society, the individual, and the environment.
4. trace major events in the history/evolution of technology.
5. demonstrate an understanding of the steps in problem solving.
6. apply creative problem-solving skills through the design process and modeling techniques.
7. develop and apply measuring skills through practical application.
8. demonstrate acceptable standards of safety in the laboratory.
9. develop a technological vocabulary and display a working knowledge of technological terms.
10. understand the importance of keeping pace with technology.
11. employ a wide range of communication skills including writing, recording, drawing, modeling, and speaking.

12. develop an understanding of the elements of a technological system including the necessary resources and processes employed and the possible outputs resulting from the system.
13. employ various techniques to document progress during the design/problem solving process.
14. write a simple design brief describing a solution to a technological problem.
15. develop an understanding of control as it relates to all technologies.
16. develop an understanding of the basic elements of information and communication technolo gies.
17. describe the resources of technology including energy, tools/machines, materials, humans, information, and capital.
18. promote an appreciation of the necessity of continual learning as a member of a technological society.

IV. Course Content

Approximate Number of Weeks per Unit (9 week cycle)

A. Introduction to Technology	1
B. Design/Problem Solving in Technology	2.5
C. History/Evolution of Technology	1
D. Systems of Technology	1.5
E. Resources of Technology	1
F. Control/Robotics Technology	1.5

V. Course content by topic outline

A. Introduction to Technology

1. What is technology

a. Definition

b. Relationship between science and technology

c. Meeting needs and wants

2. Categories of Technology

a. Physical

1. construction
2. manufacturing
3. power/energy
4. transportation

b. Information

1. transfer
2. storage
3. communication
4. education

c. Biological

1. medical
2. environmental
3. agricultural
4. food processing

3. Problem-Solving Approach

a. Application

b. Documentation

B.Design/Problem solving in Technology

1. Problem Identification

a. Design Brief

b. Specifications

2. Gather information

a. basic Research

b. applied research

c. retrieving

d. describing

e. experimenting

3. Develop Solutions

a. brainstorming

b. trial and error

c. past experience

d. insight

e. accidental

f. sketching

1. pictorial
2. oblique

4. Evaluate and Select solution

a. criteria

b. optimization

c. scoring chart

d. trade offs

5. Planning

a. technical drawing

b. material list

c. steps and procedures

6. Making & Construction

a. layout

b. cutting

c. shaping

d. assembly

e. finishing

f. safety

7. Testing

a. specifications and criteria

b. computer simulations

c. prototype testing

d. implementation testing

8. Evaluation

a. successes

b. improvements

c. impacts

C. History/Evolution of Technology

1. Time periods of technology

a. Stone Age

b. Metal Age/Greek-Roman civilization

c. Dark Ages

d. Scientific revolution

e. Industrial

1. England
2. America

f. 20th century

1. machine age
2. atomic age
3. space age
4. computer/information age

2. Historical Inventions

a. Communication

b. Transportation

c. Agriculture

d. Medical

e. Power/energy

f. Manufacturing

g. Construction

D. Systems of Technology

1. Utilizing resources

a. Tools/machines

b. Materials

c. Information

d. Energy

e. Processes

2. Combining in processes

a. Processing materials

b. Processing information

c. Processing energy

3. results in outputs

a. Expected/desired

b. Expected/undesired

c. Unexpected/desired

d. Unexpected/undesired

4. Other impacts and consequences

a. Personal consequences

1. physical effects
2. emotional effects

b. Social consequences

1. environmental effects
2. economic effects

E. Resources of Technology

1. Tools/machines

a. Extend human capabilities

b. Basic principles

c. Parts of a machine

d. Types of machines

e. Functions

2. Energy

a. Forms

b. Sources

c. Conversions (processing)

3. Information

a. Elements

1. signals
2. symbols
3. codes
4. noise

b. Signals

1. analog (continuous)
2. digital (discrete)
3. mixed

4. Materials

a. characteristics

1. physical
2. chemical
3. magnetic
4. electrical
5. thermal

b. Functions

c. Processing

1. shape or contour change
2. separating
3. joining or fastening
4. coating
5. addition
6. mixing or formulating
7. weaving or interlacing
8. internal change

5. Humans

a. Occupations

b. Training/education

c. Team/group approach

6. Capital

7. Time

F. Control Technology

1. Introduction

a. defining control technology

b. examples of control technology

c. relationship to systems model

2. Types of Control

a. mechanical

b. electrical

c. electronic

d. hydraulic

e. pneumatic

3. Creating/controlling movement

a. Simple machines

1. levers/cranks
2. gears
3. pulleys
4. wheels/cams
5. mechanisms

b. Motors

1. ac/dc motors
2. voltage/amperage
3. stepper motors

c. sensors/switching mechanisms

1. mechanical switches
2. magnetic switches
3. mercury/movement switch
4. photo-voltaic/light switch
5. sound switch
6. moisture switch

4. Computer Control

a. Interfacing

1. game port
2. I/O port
3. serial/parallel ports
4. interface cards

b. Programming

1. basic
2. logo

c. Control in the future

1. home automation
2. automation
3. cybernation

PART III
RESEARCH REFERENCES

A narrative summary of research references which support the technology education unit/activity. References describe how the unit/activity enhances student learning.

The program and course content of Technology Education classes assists students in developing insight as well as rudimentary understanding of the application of technological concepts, processes and systems

There are many references which support the practices we use in our classroom, but first it is important to clarify those methods and practices. The overall method of instruction is to have students learn and apply the design/problem solving approach to the different activities they do daily in class. This, coupled with the modular work station, forces students to think on their own, develop their own solutions and analyze their own work. Students work on their own, in teams or groups as they rotate from station to station completing different modular activities. stations include problem solving with structures, technical modeling, control-robotics, and computer graphics. Each station is a self-contained module where students apply the problem-solving methods to gain an understanding of technology. General instruction is provided during lessons in the beginning of each class following the New Jersey Level 1: Introduction to Technology Curriculum designed by the Commission on Technology Education (COTE). The concepts taught during these short mini-lessons are the driving force behind the curriculum and what the students learn at the work stations. Unlike other curriculum that use clusters of technology as a driving force behind the curriculum, ie. Wisconsin model of: construction, Manufacturing, Communication, Energy and Power), we use broad concepts identified as generic to all technological systems as established by New York and New Jersey. This model uses modules such as problem solving, resources, systems, control and evolution of technology. The technology learning activities at each station reinforce and bring clear concepts learned in the lessons.

As brought up in Technology, A National Imperative (1988), The program and course content of technology education classes assists students in developing insight as well as rudimentary understanding of the application of technological concepts, processes and systems. Using hands-on activities, laboratory projects are completed applying tools, materials, machines, processes and technological concepts safely and efficiently. We offer activities which develop students problem-solving and decision making abilities involving human and mate-

rial resources, processes, and technological systems. These activities are action-based. Designing structures for load testing, creating computer graphics for persuasion of desired actions (safety, conservation), building and programming Lego robotic devices and modeling, are hands-on activities requiring decision making, problem solving applications. These activities provide an opportunity for students to make meaning of technology, rather than merely consume information. As the ASCD Curriculum update (Sept. 1990) states, "...schools need to help produce students who are active learners and who are able to reflect critically on their own learning." To this end I see our practice of having students complete a self evaluation of all their work vitally important.

"Technology Education is not only a subject area, it is a way of learning, a way of integrating many subject areas, and a way of providing opportunities for critical thinking. By integrating all areas of the curriculum, Technology Education allows the student to think critically, to respond with flexibility and confidence, and to initiate technological problem solving and investigation as a means of learning." (COTE, 1989) Students learn from each other and form hand-on experiences as they go through the technological problem solving process, and their activities tend to unite the school curriculum. In September 1989 issue of Educational Leadership, futurists suggest that in the future learning will be centered around ideas and problems, not fragmented into discrete subject areas. Educational leaders call for a curriculum that is activity and idea based, a transdisciplinary one. It further states that "the complexity of today's problems requires us to draw solutions from knowledge in a variety of fields in order to foresee other problems that may be created by shortsighted solutions." It says "to continue to narrowly compartmentalize curricular content may inhibit youngster's abilities to generalize and see productive relationships or to be effective solvers of complex problems."

> ***"...schools need to help produce students who are active learners and who are able to reflect critically on their own learning."***

Our technology program, and in particular our modular work stations approach, breaks down the artificial barriers inherent in the discrete packaging of subjects and knowledge known as departmentalization. These modules bring together al these seemingly unrelated packages of knowledge because work stations use a holistic mind and hand approach to education and learning thus heightening the curriculum's relevancy. We believe our interdisciplinary approach will help students better integrate strategies from their classroom studies into the larger world. "Many educators and business leaders believe that the strict departmentalization of school must be discontinued in order for students to see the interconnections between subjects and between school and the rest of the world."(Mc Haney, 1988) According to Lysik (1988), the job of educators is to take separate and discrete curricular strands that have been artificially separated and weave them together. That is what our technology activities do, they allow the student to pull in knowledge from other courses and apply them to solve problems. Whether students are applying scientific principals to structures and mechanical devices or using language arts to document results of their activities, they are crossing classroom barriers to become holistic learners.

PROBLEM SOLVING WORKSTATIONS

"Success should be immediate and recognizable with a sense of achievement attached to it."

One major shift in my method of instruction would be in the relationship of teacher and learner...The new paradigm of learning society shifts the responsibility for learning to the learner

In the study of the U.S. Department of labor, Workplace Basics: The Skills Employers Want (1988), it is stated that "knowing how to learn is the most basic of all skills because it is the key that unlocks future success." This is important because of the rapid advancement of technology and the ever increasing amount of information available. Equipped with the skill to learn, an individual can achieve competency in all other basic workplace skills from understanding technology to leadership. The report notes that learning is now a fact of life in the workplace. Even routine jobs are evolving as the demands of the workplace expand. Competitive pressures compel employers to shift employees between jobs and responsibilities, putting a premium on the ability to absorb, process and apply new information quickly and effectively. The complexity, amount and availability of information compounds the issue." One of the roles of our work station approach is to force students to identify their problems, perform their own research and develop and test their own solutions. This coupled with the guided application of the design/problem solving process allows students to actively practice learning on their own. Benjamin (1989) states that educational futurists call for active learning to be understood in two ways. First, students need to participate in learning activities in which they actually engage in the learning process. Second, students must be more active in determining their own education progress. "They must be given more autonomy and power of choice."

As stated, we need to change the emphasis from what to learn to how to learn. The shift has been from content to process. This process approach can be viewed in our program as student evaluation carries more weight on documenting the problem-solving process than on the actual project (60/40). This process also places the student as an individual in the limelight as each student progresses at different rates using their unique qualities. Rigid curricular and standardized procedures cannot meet the needs of all, or even of most students. "Thus a program of education must be flexible and must start with the student rather than with externally-mandated requirements... to help students make choices and to participate in directing their own education" (Rothenburg, 1990). This flexibility is offered at work stations as there are many avenues for the student to follow and open-ended activities through which to learn.

Education begins with students interest, but interest also needs to be sparked. be connected to the students experiences and concerns. Students learn through

be connected to the students experiences and concerns. Students learn through techniques designed to encourage active exploration and discovery. Individuals and small groups perform experiments and conduct independent research—active approaches that encourage creativity and train students in learning techniques. After visiting our program, George Fricke, Chairman of the Commission on Technology Education, and Charles H. Howarth, Jr., Executive Director of the planned Sci-Tech Center at Liberty State Park, both commented on how the program gets to the root of what we are trying to teach—how to solve problems.

To develop students who can direct their own educational pursuits, Helping students learn how to learn

In the Technology Teacher (January 1986), Baker, Professor at Texas A&M, states that"students can learn problem solving in a school setting and apply it long after the student has left formal schooling. Thus. a skill learned in a school laboratory can be applied to a situation in business, industry or the arts at a much later period in the students life." This learning of the problem-solving process is not an easy task and takes careful consideration on the part of the teacher. Just dumping students into a situation will not suffice nor will a rigidly structured activity solve the problem. Care must bve given to structure activities to develop skill one step at a time. As Baker explains, an attempt to provide structural problem-solving activities should be made so the student receives maximum benefit from their experience. "It is best when it is organized from the simple to the complex and there are repeated exposures with each exposure getting progressively more complex or demanding, always establishing an attainable goal for the student. Success should be immediate and recognizable with a sense of achievement attached to it." In our program, students have many repetetive chances to practice the design/problem-solving process, and each attempt becomes more complex. All activities have attainable solutions with a high degree of project completion satisfaction taking place. Activities challenge the brightest as well as being attainable by the student with learning disabilities. In Work Place Basics, it sates that employers desire employees who "get things done (goal setting/motivation), think on their feet (problem solving), who can come up with innovative solutions when needed (creative thinking), and who can work with others to achieve a goal (team work)." All these personal traits are stressed in our program and are constantly practiced and refined by the students. One of the major changes this has created in my teaching style is to change my method of instruction. As Benjamin (1989) advocates, "one major shift would be in the relationship of the teacher and the

learner. This old paradigm made teachers responsible for the students learning, with the student obliged to learn. The new paradigm of learning society shifts the responsibility for learning to the learner." This change in teaching methodology encourages a partnership with students as we all travel the educational road.

In a speech by Anton Campanella, President of New Jersey Bell, he called for Industrial Arts teachers to "develop and bring to the classroom a new interdisciplinary concept—Technology Education." He stated that through this approach, New Jersey students—its future workforce, its future consumers, its future parents—will engage technology, understand it and be better able to apply it on the job and in their lives." In our program we emphasize repeated hands-on activities and actively-involved minds to work through the educational activities to reach their goals. Students use and learn proper and safe use of various tools, machines and equipment of industry and technology. They learn how these resources can help to satisfy needs and wants of people.. They use various materials to solve problems and manipulate them applying many processes and techniques of industry in the world of work. They learn how to create and control everyday technology and employ many methods to evaluate their ideas and solutions. Students work on activities identified in the New Jersey Level 1: Introduction to Technology Curriculum as being vital to a thorough understanding of technology. activities include design and construction of various types of structures, modeling modes of transportation, designing graphics for communication using the computer and exploring mechanical/electrical devices related to computer control. All work station modules inspire students to apply problem-solving and are of high motivation to both male and female students.

Many of my activities are variations of selections in technology textbooks and magazines and have been tried and proven over the years. My Technology Learning Activities (TLA's) have been disbursed at many workshops, conventions, and open houses and are being used by programs throughout the state with equal success. There is not a week goes by that I do not get a call for information on a TLA or requesting a visit. The activity used at our control-robotics station, using Lego-Technic components, has recently been highlighted in the Lego-Logo Users Fall Newsletter as a model activity in technology.

There are many more references promoting technology education as a viable, necessary course of study. What I have presented are just a few that support the methodology we employ—the application of the problem-solving process to develop students who can direct their own educational pursuits—helping students learn how to learn.

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PROBLEM SOLVING with WORKSTATIONS

The following is an excerpt from the evaluation report submitted by Dave Weischadle Dr. Ed. Montclair State College performed under contract by Randolph Board of Education and N.J. Department of Education Director of Voc. Ed, performed May 1991 at Randolph Intermediate School Introduction to Technology classes

PART IV
Program Evaluation

Discussion of Outcomes

The basis of the project is a series of four work stations, each of which are related to one of the four sub-sections in attachment A:

- Designing with Structures
- Control/Systems Technology
- Technical Modeling/Resources of Technology
- Computer Graphics Presentation

Each student, during the 9-week cycle of participation, selected two or three work stations and carried out an individual program. While each individual developed his own learning packet, he or she generally worked with another student as part of a team. In addition to producing the packet, the student conducted research, took tests, responded to questionnaires, applied study skills, used simple tools as well as complex hardware and software, and made a formal presentation.

All students in grades 7 and 8 participated. Overall, approximately 310 students completed the project. Each marking period (9 weeks), a cycle of about 80 students participated. Consequently, all students are expected to benefit from the project and gain from the experience.

Criterion 1:

Developing technological design and problem-solving skills (which include all of the following analyzing and investigating; framing a design brief; gathering information, generating alternative solutions; choosing a solution; designing and developing; and fabricating a prototype and testing and evaluation)

Included in the application is an extensive description of each work station. In this description the project teacher defined the specific ways the classroom instruction will approach the funding criteria. The materials in the classroom located at each work station support the described activities. During the classroom observation, the students were performing in the manner in which this description suggested they would. The documents produced by the youngsters also supported the project description in terms of the activities ascribed to each work station.

The documents produced by the youngsters also supported the project description in terms of the activities ascribed to each work station

Each work station was based upon the 9-step problem solving approach that is directly related to the technology effort. Students, however, had control over what work stations they did, being able to complete two or three of the stations during the 9-week term. A review of the final documents from this mix of seventh and eighth graders indicated that the process was well ingrained. The documents reflected the use of the 9 steps, with a great emphasis on the drawing and graphics aspects. the range in detail and length of the document varied from the type of problem selected and the solutions offered.

The essence of the entire project was focused toward the elements of this funding criteria. The curriculum, lesson plans, teaching material, and student products reflect in a very substantial fashion that the project teacher offered learning opportunities which initiated the concept early in the term and continued to reinforce the concept throughout the term. Student documents were selected at random, coded, and labelled alphabetically; e.g., Document A. Over fifty percent of the documents examined showed that this group used the computer extensively to assist in the analysis and the proposed solutions. Students who produced Document D noted: "We learned basically how to use the Print Shop and Graphics Expander programs and how to go from one program to the other. By the end of two weeks we were 'pros' as using the computer." In addition, the design work station used a program examining the style of an auto and the effect wind has on its features.

In actual class activities, students appeared to use their drawings to guide their thinking and actual building of the devices they designed

A random review of student documents also supported these outcomes. Most students seemed to find the drawing and descriptive aspects of the technology process very attractive. The documents contain a number of drawing of both alternative solutions as well as the final solution. Document H contained a number of drawings of aerodynamic shapes which the students considered as alternative styles for the prototype. The students thought the work station was "challenging and would be fun to do."

In actual class activities, the students appeared to use their drawings to guide their thinking and actual building of the devices they design. Clearly, the students depended on their own ability to shape the device which their thinking suggested would solve the problem. In the Structures work station, two students (Document C) noted that "we first sketched what we wanted to do. Then we used the drawing board along with rulers" to further design the project.

Criterion 2:

Reinforcing concepts in science, math , language arts and other subjects

A review of the documents produced by the students indicate that technology depends greatly on their ability to apply many principles presented to them in subject areas related to science and mathematics. In the Technical Modeling work stations, students were involved in shaping the body of an automobile aimed at reducing drag. They were extremely aware of the aerodynamics and its impact on the speed and handling of an auto. In addition, students were also to design structures (e.g., bridges) within specific parameters that would support a pre-determined weight. Consequently, it can be con-

cluded that the students were employing scientific principles in resolving their problems. In addition, basic mathematic measures, including the application of scale and ratio, were employed by students in appropriate fashion. For example, a student in one class was observed building a recreation hut and swing set that was carefully drawn to scale. She was careful measuring the material and constructing the finished pieces exactly according to the drawings.

In order to complete the "Lego Station," students must calculate gear ratios to determine mechanical advantage. This calculation required some algebra which was taught as part of the technology course. Overall, there was a clear train of activities which began with planning, theorizing, calculations, and testing. Both skills in mathematics and understanding of science were reflected in the data collected and conclusions reached. Similarly, in the design and construction of gliders and airframes, students showed an understanding and skill in several related areas. For example, in Document H, the students collected data on wing span, length, center of pressure, range, altitude, and landing for a number of alternatives, and then selected on which best satisfied sound aerodynamic principles. In this case, the study of aerodynamics was directly related to work being done in the student's science class.

Not only were students able to discover some answers to problems, they had to explain them in the portfolio they produced.

In another class observation, students were designing graphics which would be created using a computer program. They were carefully laying out the scale of the lettering, considering relationships of the print and picture, and weighing the influence of color of the message being offered. Much of their time during the observation was being focused on how well the actual graphic met their original plans, and what they needed to to in order to correct the graphic.

The documents were important ventures in the field of language arts. Not only were students able to discover some answers to problems, they had to explain them in the portfolio they produced. The documents themselves were opportunities to write about their self-directed activities. On many documents, the project teacher offered criticism of spelling and clarity of meaning. Overall, the students were able to describe their process using the 9-step approach. particularly noteworthy is the project teacher's emphasis on research. Students are encouraged to use the library as well as data basis available through computer modems. The levels of research was particularly well evidenced in one document, (Document A), which showed extensive research on airplanes and aerodynamic principles.

Criterion 3:

Developing basic skills in the proper use of tools, machines, processes, products, and services of industry and technology;

Clearly, the final products developed by the students reflect some very successful outcomes in this particular area, which is best presented by simply listing some observations:

- Students produces some devices which reflected an ability to use tools to finish the product (e.g., file, sander, saw and glue gun).
- While wood was a prime substance in building the products, students also used plastics, clay, paper, styrofoam, and composite material to build their devices.
- Gluing and grooving were used frequently, rather than nailing or stapling.
- Available material and components (e.g., gears, Lego, and motors) were used in a variety of fashions.
- Extensive use of the classroom computers were evidenced.

Students in classes observed, indicated they were very familiar with the tools, materials, and process. One young woman, who was deeply involved in building a structure, frequently went to the band saw and sander, cut and finished her wood piece, returning to her project with the improved component. Each time, she put on her goggles, checked her hand locations and started the saw. Her techniques were safe, yet also reflecting good instruction in how to use this potentially harmful equipment.

Criterion 4:

Developing fundamental concepts of how people create and control their environment

Observing students in the classroom and informally discussing their project revealed that students were very aware of how they were in control of their projects. They were the designer, implementer and initial evaluator of whether their ideas were reasonable and workable. The youngsters in the classroom described what they were trying to accomplish, what had not worked, and how they reached their present solution. Their comments reflected a comfortable understanding of what the work station was dealing with and how they were to function with the tools, process, and material.

Criterion 5:

Developing a team approach to learning

In this relatively small class that had been together for a few weeks, there seemed to be a rather natural and relaxed ability to work both as individuals and in teams. Indeed, most of the students on the days observed had both formal partners as well as informal partners in the class. There seemed to be a great deal of willingness to share and to observe what others were trying. The openness and camaraderie of the group tended toward a generalized movement toward a solution that was based on input from many members of the class. Adding to this general atmosphere was the instructor who moved about and discussed openly the criticisms he had about the processes that were employed.

Criterion 6:

Identifying jobs and related education for technology-related careers

The curriculum and teacher interviews indicate that students are instructed in this area. Students generally indicated that they saw important aspects of technology in such careers as computers and computer-re-

lated areas of manufacturing where robots are employed. Particularly noteworthy in the intermediate school project was the presence of girls in the class. Because all students take the course, girls were enrolled. In actual practice, the girls seemed as comfortable at the work stations as the boys. The young women seemed as intrigued and enthused about creating and building as the boys did.

KEY EVALUATION QUESTIONS

Question 1:

Did students have the opportunity to learn those general ideas and skills addressed in the funding criteria and project description?

Clearly, students had the opportunity to learn the principles and concept outlined in the funding criteria. The work station concept is flexible, challenging, and productive. As pointed out in the above discussion, students were actively involved in the systematic process outlined in the funding application, using the 9-step approach to tackle real and meaningful problems. Having received instruction in the process and in specific areas they were expected to deal with, the students performed as would be expected. Working on projects of their choice, students were actively using tools and applying technology to solving problems related to the four general areas of the project. The documents they produced followed the systematic approach addressed in the criteria, yet reflected their own style and level of proficiency. In the classroom, they appeared comfortable with the terminology and were actively following the steps.

Particularly attractive here was the large number of students involved (over 300) and the fact that the classes included both boys and girls. In terms of the large number of students, the project certainly is extremely cost effective, both in terms of short range estimations as well as long term. Immediately, every seventh and eighth grade student benefits from the program at an extremely low cost. Long term, the benefits come from the professional development of the teacher, the refinement of the instruction and instructional material, and the utilization of the equipment to be purchased over the next five-to-seven years.

While technology education offers great learning opportunities, there has been few efforts to include large numbers of girls. This project moves greatly toward opening up this vital concept to girls who have the interest and skills to explore how technology can improve society. Even more important, it offers the opportunity to girls who have not thought about the importance of technology at all. Within the framework of the classes observed was an atmosphere of encouragement and support which the young women seemed to thrive upon. They approach the simple tools as well as the more complex ones with a surety and confidence not frequently seen in today's world.

Question 2:

When given those opportunities, did student work reflect appropriate learning?

Effective thinking processes as well as learning a number of skills related to technology were obvious components of the project. In this particular case, where choice is a key element of the learning process, students were motivated by what seemed to be an interesting problem and proceeded to tackle the solution. Based on the documents, the students appeared to be learning the appropriate concepts, ideas, and information for this age group. Because of the indirect, learn-by-doing approach, the element of

choice, and the high degree of individualization, it is difficult to establish a standard against which to test the level of learning. When the involvement of more than one student is added, it becomes even more difficult to know the exact level of accomplishment by any one student.

Nonetheless, while these factors are a disadvantage on the one hand, the opportunities offered by each work station must be seen as advantageous relative to the funding criteria. Students worked together, either formally or informally, and produced highly individualized documents or portfolios and working models. If one were to use these as criteria in a general sense, the students must be seen as active learners, able to produce working devices based on their thinking and creativity.

Even more important is the opportunity to exercise choice. Students can select the work station they wish; they also can select their partner. Once into the work station, they have the opportunity to select alternative solutions and pursue the one solution they feel best suits the task. The opportunity to make such choices in a school setting is a significant learning opportunity. It allows the student to test his or her judgement and determine how well the decision tested under actual conditions.

Question 3:

Are the curriculum approaches and materials appropriate for the general ideas and skills presented in funding criteria and project description?

In reference to the funding criteria, the activities associated with the project appear to be most appropriate. Guided by the curriculum and the teacher, both of which reflect the technology education model, the work station activities deal directly with the 9-step process. The 9-step problem solving approach is a reasonable and sensible concept which students find useful in dealing with the work stations. in addition, the activities lend toward applying concepts and ideas to real problems, giving the students and teacher the opportunity to fashion any number of student activities. At the same time, there is an ever-present element of consistency running from the curriculum material to teacher lesson plans to actual classroom activity. While there is a great deal of flexibility, there is nonetheless a clear structure which guides student learning.

Question 4:

What are the strengths and weaknesses of the current activities?

The technology education model fosters the application of a systematic approach to using technology to solve human problems. This factor represents the primary strength of the project. The four work station operate using the nine-step approach. Students are able to focus on how best to deal with real issues and apply innovative approaches to the resolution of those concerns. Clearly, the approach provides students with a workable model to test ideas and reach conclusions.

Individualization of instruction and student learning marks and important second strength of the project. The student becomes the responsible learner in this approach and is required to present his thinking process from beginning to end. The production of the document necessitates the student to address each area and develop a logical response. Working within a set of parameters, the student is nevertheless able to balance intuition with reasoned analysis, to execute a set of plans he or she has designed, and share his or her ideas with others, gaining a better understanding of self and the value of his or her thinking.

Also important is the issue of choice and the seeming im-

pact it has on student motivation. Students observed in the classroom working at the stations are active learners, searching for solutions, discussing their ideas with team members or other students. The lively climate of the classroom reflects the value of peer influence and support. In one observed instance, a student literally encouraged another to try shaping the model according to what the first student thought was whimsical in order to test how it would work. Frequently, one student would assist another working with a computer, a small tool, or a piece of material.

The simplicity of the technology education concept is also a strength. Most teachers could well develop an understanding of technology education and use their ingenuity and skill to use the concept which the project has developed. In addition, the material used in the course are sufficiently developed so that teachers can adopt them in current courses, or plan to develop a technology education course. Furthermore, technology education blends well with the national movement to foster critical thinking in the schools.

The production of a student document or portfolio is very beneficial in that it is something which the student and teacher can identify with personally. In many ways, such documents reveal more than any standardized or teacher-made test can. In describing the concept of "portfolio" or document, Paulson, Paulson, and Meyer ("What makes a Portfolio a Portfolio?" Educational Leadership, February 1991,).

Portfolios have the potential to reveal a lot about the creators. They can become a window into the students' heads, a means for both staff and students to understand the educational process at the level of the individual learner. They can be powerful educational tools for encouraging students to take charge of their own learning.

In this project, and its companion project at the high school, the portfolio or document clearly approaches the classic model of the concept.

By not having specific, measurable standards for the objectives provided in the project description (Appendix A), both the project and funding source limited the level of specificity related to learning advances. Nonetheless, the next step of adding performance standards is quite reasonable and should prove beneficial. The grant source and the applicant should be commended for taking such an approach, for it is the very nature of grants to fund the experimental.

The project specifically promotes science, mathematics, and language arts is shown in the description. It is obvious in many ways that the project does require an understanding of scientific principles, the use of mathematical concepts and techniques, and an ability to communicate, but it is unclear in any specific way which skills should be addressed. This weakness can be corrected by simply identifying those key understanding and skills, instructing the student in the, and then reviewing the documents to determine if the student employed them.

Question 5:

What changes or modifications can be designed and implemented to improve current practices?

The project teacher should continue to develop behaviorally stated objectives and establish some standards in science mathematics, and language arts which could be addressed and measured in order to address any shortcoming related to student outcomes. One approach is to require students to address a scientific principle (e.g. air pressure) and a mathematical procedure (e.g., ratio of gears) in discussing the selected solution in each of the work stations.

In preparing the course material and descriptions of the work stations, a professional writer and graphics person could assist in this effort as well as help in the development of "camera-ready" instructional material for dissemination. Such a professional could create attractive student material and handouts that would add a measure of assistance in explaining what is expected of students.

The purchase of additional equipment will greatly enhance the work of the project. At present, the project teacher is using currently owned computers, materials, and tools to operate the work stations that have been gathered from a number of sources. Some of those items are dated and need upgrading; others belong to other activities. The equipment included in the funding application will help the project teacher to organize the course's activities and structure the learning opportunities.

Question 6:

Are activities of the project appropriate for dissemination?

The project teacher is actively involved in technology education and is frequent speaker and presenter throughout New Jersey. Consequently, the project activities are already being disseminated, simply because teachers see the benefits of the idea. The concepts and principles of the Randolph project are generally known and, many teachers, in the natural course of events, acquire the techniques in the form of handouts and activities and use them as part of their teaching. If the material is to be duplicated on a wide level, the classroom material needs some graphics and technical layout assistance to make them attractive and visually pleasing. This widespread sharing of ideas is one of the most powerful dissemination processes available, and is already in process. Further dissemination of more finished products would certainly encourage other teachers to try this alternative approach from a more traditional, highly teacher-directed instruction.

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Findings

Based on the discussion presented above, this evaluator offers the following findings:

- **The students enrolled in the project participated actively in learning activi ties directly related to the funding criteria upon which the project was sup ported. .**
- **The project teacher and Randolph staff carried out the activities for which they were funded in an appropriate and professional fashion.**
- **The work station concept clearly offers an approach that build on choice and the motivation associated with self-direction and experiential learning.**
- **The project will be greatly enhanced by the planned purchase of the equip ment and its use in the classroom.**
- **The use of the student documents or portfolios represents a significant and beneficial educational approach to individualized learning.**
- **The course is especially cost-effective due to the large number of students enrolled.**

PROBLEM SOLVING with WORKSTATIONS

SUMMARY OF PROGRAM DESCRIPTION BOOK 1

Technology Problem Solving Workstations

The stations are designed to encourage active exploration and discovery as students perform activities related to the cutting edge of technology.

Program Overview

Problem solving in our technology lab is based on a self-directed, self-paced instructional system, placing the responsibility for learning directly on each student. Each module contains self directed technology related activities where students define problems, complete research, develop solutions, build models, and evaluate results as they relate to each station. This problem solving approach is the overriding theme which links all modules together.

The stations are designed to encourage active exploration and discovery as students perform activities related to the cutting edge of technology. In the module Control/Robotics Technology, students use Lego modular building components to construct models that are computer controlled, electronically censored devices that they have researched, developed, programmed and evaluated all on their own. Students at the Transportation Modeling station, explore futuristic designs of flight and land vehicles. Students perform computer simulations, build prototypes for wind tunnel analysis and test models for flight characteristics or land vehicles on a magnetic-levitation track. As some students rotate to the Structures station, they explore different kinds of structures. Following the design process, they create a structure for load testing or build a replica of a historical structure or design a structure for the future. Another station includes Computer Graphics where students explore desk-top publishing, multimedia presentation, CAD and computer applications.

Program Objectives

This program is designed to help students learn and apply a design-problem solving process while becoming directly involved with the technology of today and the future. Students will have the opportunity to play a variety of roles and sample a number of different career fields. Students develop basic design and communication skills to document their progress as they apply the tools, machines, materials, processes, and resources of industry and technology.

PROBLEM SOLVING WORKSTATIONS

What the Research Says

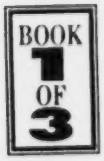
In the study by the U.S. Department of Labor, Workplace Basics; The skills Employees Want (1988), it is stated that "knowing how to learn is the most basic of all skills because it is the key that unlocks future success". One of the roles of our workstations approach is to force students to identify their own problems, perform their own research and develop and test their own solutions. This coupled with the guided application of the design process allows students to actively practice learning on their own. As brought up in Technology, A National Imperative (1988), the program and course content of Technology Education classes assists students in developing insight as well as rudimentary understanding of the application of technological concepts, processes and systems. Using hands-on activities, laboratory projects are completed applying tools, materials, machines, processes, and technological concepts safely and effectively.

Special Resources

To effectively teach a program such as this, one needs to develop workstation modules which reflect current and futuristic technologies. Basic hand tools and craft machines are necessary to complete the model building in the design process. Computers play an important role as it attracts and motivates young students in the technology modules. Various flexible consumable materials are necessary for student use in prototype construction. Planning is of the utmost importance and all student instructions should be ready before starting a modular approach. A necessary area in the lab is a research and planning area where students can find information relating to their designs and develop a plan of possible solutions.

Scheduling Requirements

Scheduling is very flexible. Our program encourages students to complete two to three modules from a total of five. This is done in a six week time frame, other time periods could offer different variations depending on time available, class size, equipment and teacher experience.



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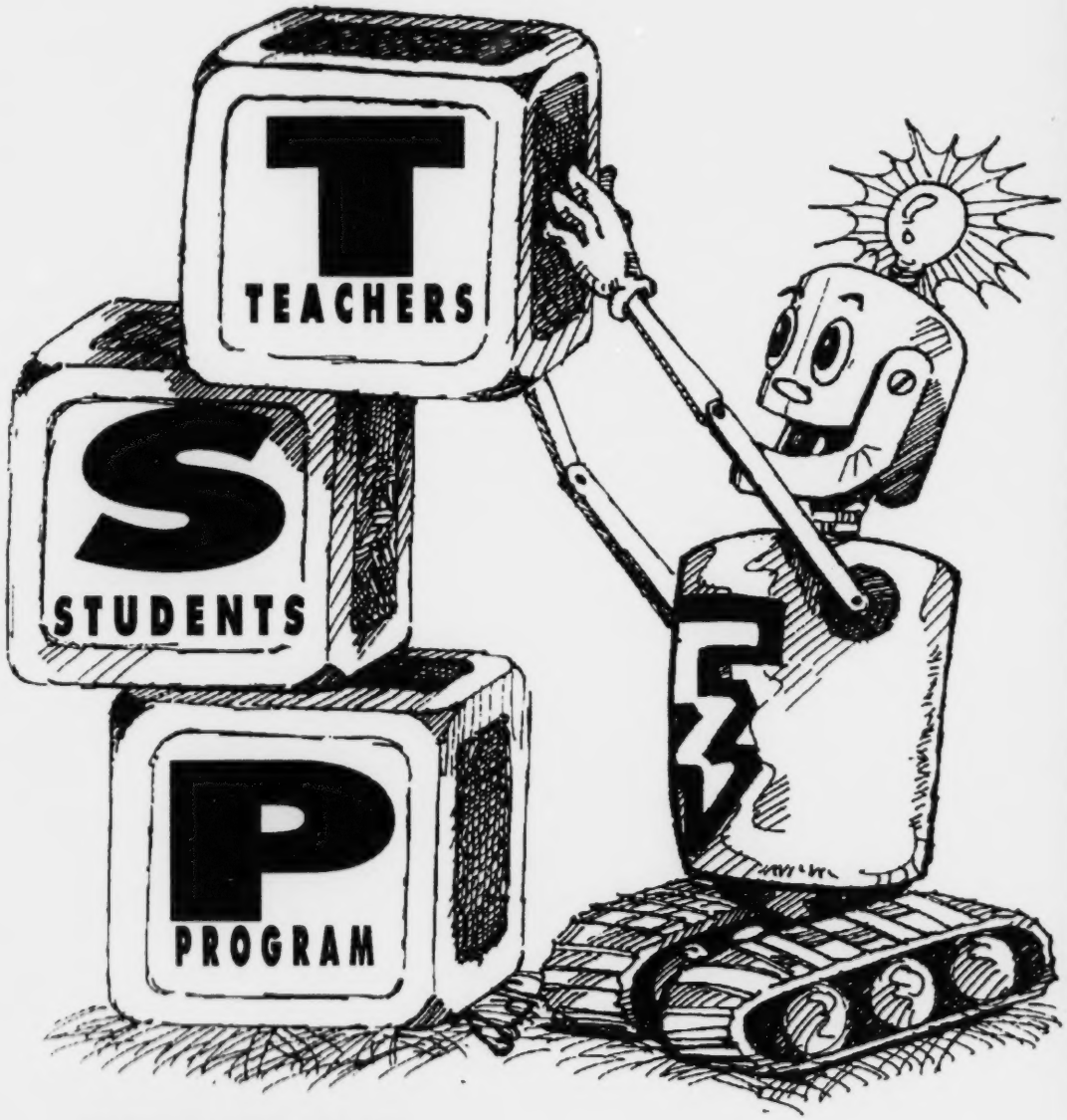
TEACHER DEVELOPED TECHNOLOGY

TD - TEN

EDUCATION FOR THE NINETIES

TEACHER MATERIALS



PROBLEM SOLVING with WORKSTATIONS

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PROBLEM SOLVING with WORKSTATIONS

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C. Transportation technical modeling
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Workstation Implementation Strategies

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Student Evaluation

This project was conducted pursuant to a contract from the New Jersey State Department of Education, Division of Vocational Education and was 100% state funded under the State Income Tax Revenue Account. Monies in this account are appropriated through New Jersey Statutes Annotated, Subtitle 7, State and Federal Aid to Schools, Section 18A:58-34 and 35. The contractors undertaking this project were encouraged to express their judgement in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official funding agency positions or policies.

Workstation Activity Use

Technology learning activities are the vehicles that deliver technological concepts. They provide the "learning by doing" aspect of the curriculum. "Learning by doing" is by no means new to teaching strategies as it is one of the best carry overs from Industrial Arts programs of the past.

The activities provided here are based on hands on learning instruction catering to a variety of learning styles. The Technology Learning Module outline provides the teacher with the basic background information needed to setup and implement a workstation approach. This outline matches up with the Design Briefs provided in the student section of this packet. This information is a basis as your own expertise and background will allow you to expand on what is provided or modify unfamiliar areas.

Let your imagination and experience be a guide as to how you approach the activities, and modify them to fit your facility, materials and budget. Classroom activities become very personal. They represent the teachers background, interest, and facilities. As you become more familiar with the curriculum, you will develop activities that better reflect your situation. The activities provided here have proven successful for my students and me. Let them serve as a starting point for your transition to technology education.

These activities are the core of my nine week long program. They are started after an initial introduction unit which involves short one to three day mini activities which orient the students to the design process, lab layout, computer use, and evaluation process. Culmination of the course involves students working on a history and evolution activity making models of historical inventions and presenting their topics to the class.

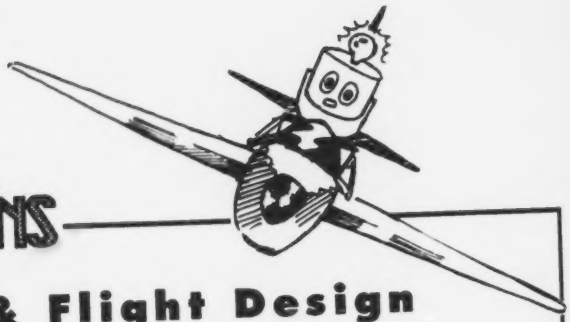
Teaching Methodology

Problem Solving Approach

Technological problem solving is the creative transformation of resources into the products, processes and services which meet our many wants and needs. The complex systems which are the hallmark of a technological society are the result of systematic efforts and not accident. If our students are to become the problem solvers of the future they must develop a thorough understanding of the formalized problem-solving method. The goal of the workstation approach is to provide students with opportunities to explore solutions to real life problems by using specific problem solving techniques.

Students should be encouraged to view the problem-solving process as a tool or system to help them organize their attack on the problem. Through the system, students will be better able to organize their information and apply previously learned experience to solving the problem. The process should be documented in the form of a portfolio and submitted for evaluation.

PROBLEM SOLVING with WORKSTATIONS



Vehicle & Flight Design

Technology Learning Module

TLM Title:
Transportation Modeling

TLA Title:
Vehicle & Flight Design

Grade Level:
7-8

No. of Days:
3 weeks

Primary Concepts:

Design/Problem Solving Process

Modeling Construction

Computer Simulation

Futuristic Vehicle & Flight Design

Prototype Testing & Evaluation

Activities

-Mag - Lev Vehicles
-Solar Powered Vehicles
-CO2 Powered Vehicles
-Balsa Gliders
-Rubber band powered airplanes
-Rockets
-SST Design Computer Simulators

Overview and Justification:

We live in a society that is reliant upon many forms of technology. These technologies give citizens choices for improving their lives. Transportation is one of the most important of these technologies. Transportation Technology has become integrated into every part of our lives on a daily basis. Because of this, most citizens today take transportation technology for granted. Since the oil embargo of 1973, our society has become keenly aware of the need to develop more efficient and economical means of transportation. In the United States, for example, the fuel consumption of the average car has nearly halved during the past decade. Developing a new design model is a very elaborate process that takes many years and large amounts of money. The newest technology, computer design, is a fascinating process that is changing the way we design as well as the amount of time it takes. This module hopes to capture some of this fascination as students go from design brief to prototype and become a designer themselves.

Performance Objectives:

Goal 1

Develop critical thinking, problem solving and communication skills.

Objectives:

- find solutions to various design problems through experimentation and analysis.
- develop, test and modify their own designs.
- document each step of the design/problem solving process.
- communicate in a team approach, sharing ideas and work to perform activities.
- employ various techniques to gather information as it related to their problem.

Goal 2

Engage students in first-hand experiences with technological resources.

Objectives:

- develop proper, safe skills in using tools, machines, materials and processes through physical modeling activities.
- demonstrate use of high-tech equipment such as wind tunnels and computers for design and analysis of their ideas.
- define design-related occupations in the world of work, and understand the training, skills and interests necessary to work in that field.

Goal 3

Students will understand the relationship of disciplines and the interdisciplinary approach to technology.

Objectives:

- define and apply scientific principles in their modeling solutions.
- apply mathematical manipulation of variables to develop a computer design that performs to stated criteria.
- develop their language arts skills as they document the design process and present the result of their work.

Goal 4

Provide students with the knowledge and techniques that are used in technical illustration and the communication of their ideas.

Objectives:

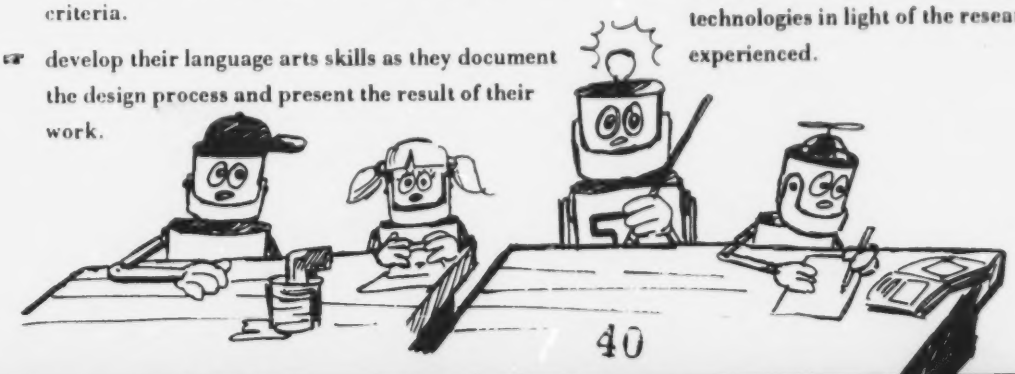
- visualize objects and sketch them to analyze their solutions.
- utilize various tools, materials and processes of the graphic illustrator to present solution ideas.
- use their illustrations to critique their effectiveness in a team or group.

Goal 5

Relate an understanding of the history and evolution of transportation devices.

Objectives:

- trace the history and evolution of the transportation device they are modeling.
- employ the systems model to interpret the impact on society that various transportation devices have produced.
- relate their understanding of transportation technologies in light of the research they have experienced.



PROBLEM SOLVING WORKSTATIONS

Vocabulary:

Design
Stream lining
Aerodynamics
Wind Tunnel
Magnetic-Levitation
Engineering
Drag
Bernoulli's theory
Laminar Flow
Air Flow
Scale
Thumb Nails
proto-type

Integrated Subjects

-Physical Science Concepts
-History of Transportation
-History Personalities
-Effect of Transportation on Society
-Art and Design
-Research and Language Arts
-Mathematical Analysis and Measurement

Vehicle Design:

Equipment & Materials

computer system - Apple IIe	balsa wood/various
various wood working hand tools	magnets
wind tunnel Kelvin/Pitsco	9V motors
mag lev track-Kelvin	plastic wheels
propellers (2-3 prop)	water base paint kits
clay tools	clay-various (non hardening)
electrical wire	solar cells
solar motors	x-acto knife kits

Simulation Software:

Car Builder	GM Sunrayeer

Flight Design:

Equipment & Materials

computer system- Apple IIe	x-acto knife kits
various balsa wood stock	sandpaper
rubber band material	modeling clay
various glider/plane kits	super jet glue
balance/stability beam	(cyrogenetic)
propellers-various plastic	wind chamber
water base paint kits	tissue paper
rocket designers kit-Estes	

Simulation Software:

Glide Path	Flight-Estes
RC Flight Simulator	Rocket Designer-Estes

Resources/References

Vehicles:

- **Automobile: From Prototype to Junkyard**, Frank Young, Gloucester Press, 1982.
- **The Great Book of Cars**, Jonathan Rutland, Ray Rourke Publishing Company, Inc., 1980.
- **Race Car**, Boyd Hanks, Quest Publishing Company, 1977.
- **Wind Tunnel Aerodynamics in Junior Engineering**, Betty Briggs & Steve Bowers, Pitsco Company, 1981.
- **Transportation in the Future**, Mark Cambert, The Bookwright Press, New York, 1986.
- **Transportation Energy and Power Technology**, Anthony E. Schwaller, Delmar Technology Series, 1989.
- **The Car**, Bruce Barnes, Scholastic Futures Publishing.
- **Omni Magazine**, "Pictorial: Future Cars", Dooley Adcroff, March, 1989, pp. 48-50.
- **Popular Science**, Racing with the Sun, Dan McCosh, November 1987, pp. 84-87.

Flight:

- **Future Flight**. Siuru, Bill & Busick, John D. Tab Books, Inc., 1987.
- **Super Flyers**. Francis, Neil, Addison-Wesley Publishing, 1988.
- **Space Exploration**. Ray Sprangenburg & Diane Moser, Facts On File Publishers, 1989.
- **The Ultimate Paper Airplane**, Kline, Richard, Fireside Books, 1985.
- **Aeronautics-Modular Course in Technology**, Page-Bloor & Henson Oliver & Boyd, 1988.
- **SR-71 Blockbird**, Drendel, Lon, Squadron/Signal Publications, 1982.
- **Space Travel**. DeOld-Judge, Davis Publications, 1989.
- **Handbook of Model Rocketry**. Stive, G. Harry, Prentice Hall, 5th Edition, 1982.
- **Unconventional Aircraft**. Bowers, Peter M., Tab Books Inc., 1984.
- **Illustrated Guide to Aerodynamics**. Smith, Hubert Tab Books Inc., 1985.

PROBLEM SOLVING WORKSTATIONS

Technology Learning Module

TLM Title:
Construction Design
TLA Title:
Structure Modeling
Grade Level:
7-8
No. of Days:
3 weeks

Primary Concepts:

Design/Problem Solving Process

Technical Drawing

Computer Design & Simulation

Modeling Techniques

Structure Physics

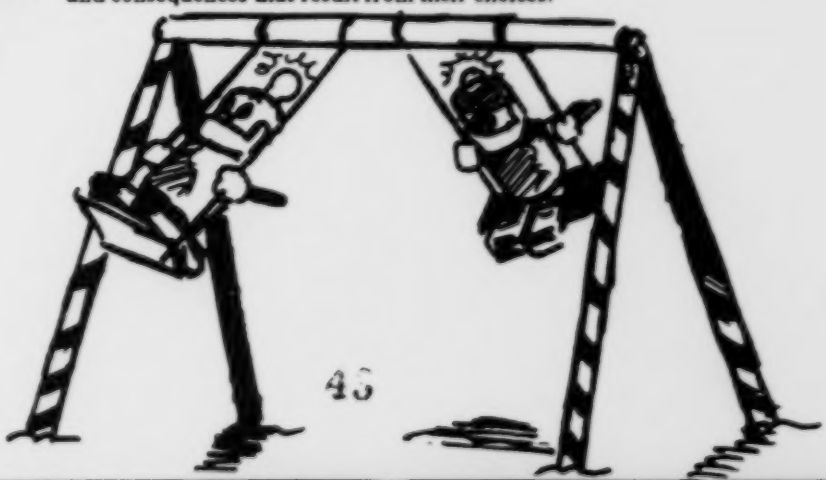
Activities

-Balsa Compresson Structure
-Competition,Truss Balsa Bridge
-Historical Structure
-Playground Design
-Deck /Outdoor Structure
-Futuristic House design
-Computer Design

Structure Modeling

Overview & Justification:

Designing is the process of analyzing, creating, planning and developing products. If we accept the idea of designing as meaning planning, it is evident that design must concern itself with the planning that goes into products and structures. It would also follow that virtually everything in daily living is in some way related to design. Designing in this light becomes an integral part of all problem-solving activities so desirable in the educational program and inseparable form daily patterns of decision making. By the application of a design/problem solving process, students will have the opportunity to play a variety of roles and sample a number of different career fields. Throughout the module, students will explore the design process in depth as they build a structure to carry a load or a futuristic prototype or even a scale model playground. They will formulate ideas, investigate information, develop solutions, select and plan a final design, then build and evaluate their results. Emphasis is placed on the students illustrative techniques as they document the design process. Students are taught skills necessary to develop sketches, technical drawings and computer-aided drawings. Students are encouraged to create products with high craftsmanship and to perform an initial self evaluation of all work completed. Students can work as an individual or as a team for more complex models. A variety of materials, tools and designs are necessary which forces all students to make choices as to the resources they use and the impacts and consequences that result from their choices.



PROBLEM SOLVING with WORKSTATIONS

Performance Objectives:

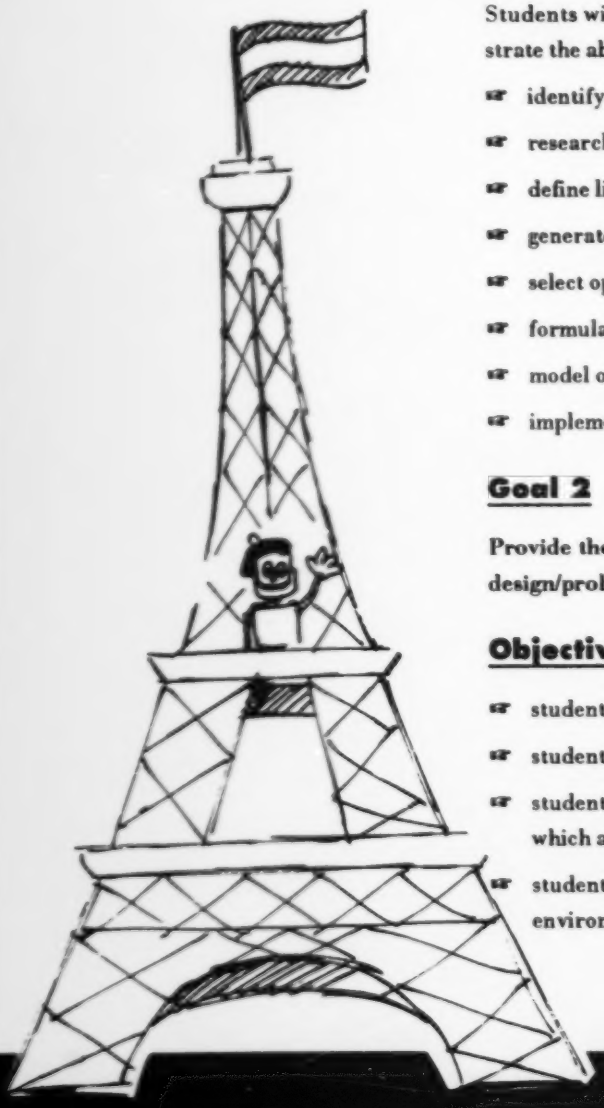
Goal 1

Focus students learning on the basic concepts, cognitive skills and processes of technological design/problem solving methodology.

Objectives:

Students will demonstrate an understanding of the process and will demonstrate the ability to:

- identify the problem
- research the problem
- define limitations and specifications
- generate alternative solutions
- select optimum solutions
- formulate plans
- model or construct solutions
- implement and evaluate results



Goal 2

Provide the student with the practical experience using the design/problem solving process on technological problems.

Objectives:

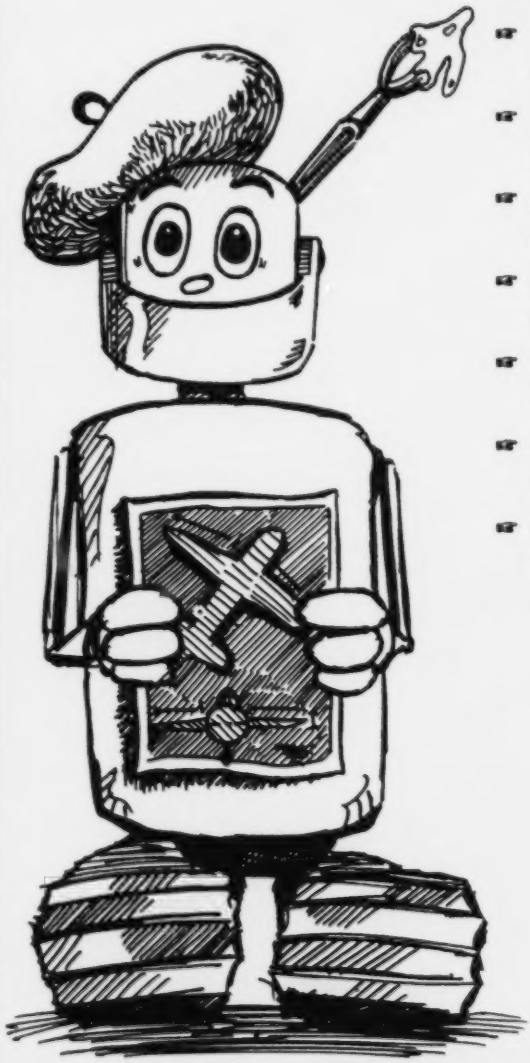
- students practice problem solving at earliest chance.
- students start problem solving in a very structured, directed sequence.
- students practice problem solving in a guided discovery methodology which allows some alternatives.
- students participate in design/problem solving in an open, unrestricted environment experiencing all steps.

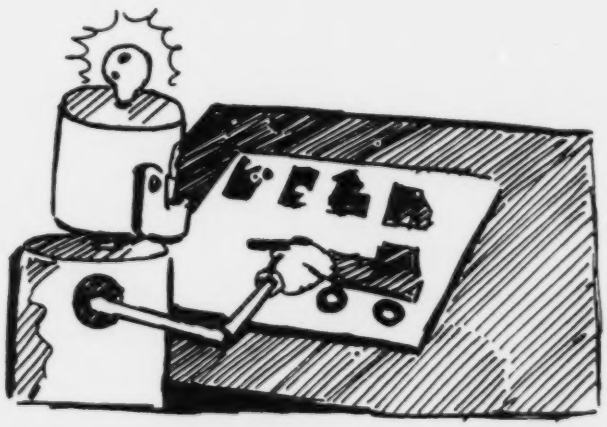
Goal 3

Develop basic design and communication skills to document each step of the design/problem solving process.

Objectives:

- develop the ability to visualize objects and draw them in perspective.
- develop skill in the choice and use of color and shading for emphasis and clarity in technical presentation.
- develop the ability to visualize objects in three view and make orthographic projection drawings of complex objects.
- develop the ability to use the computer as a tool for drawing, presenting and clarifying ideas.
- develop technical skill in the display of quantitative and qualitative infor mation.
- develop skills in the use of high-technology multi-media documentation equipment (camera, camcorder, computer multi-media).
- develop skills in the use of various high-technology multi-media equipment in the presentation of solutions to technological problems.
- apply knowledge, skills and techniques learned to document the design/problem solving process and present results for analysis.





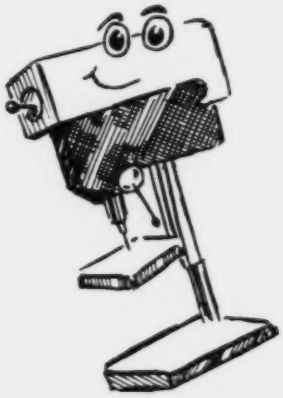
PROBLEM SOLVING WORKSTATIONS

Goal 4

Involve students in the application of tools, machines, materials, processes and resources of industry and technology.

Objectives:

- develop understanding of the different types of tools and machines, their application and proper, safe use in the technology lab.
- participate in a variety of activities which generate multiple choices and generate maximum variation of tools and machine use.
- demonstrate the ability to use a wide variety of materials for in solution development.
- demonstrate an understanding of a variety of techniques to convert materi als into useful products.
- demonstrate the ability to produce prototype models which involve various resources of technology.
- develop an understanding of the choices and impacts involved when using various technological resources.

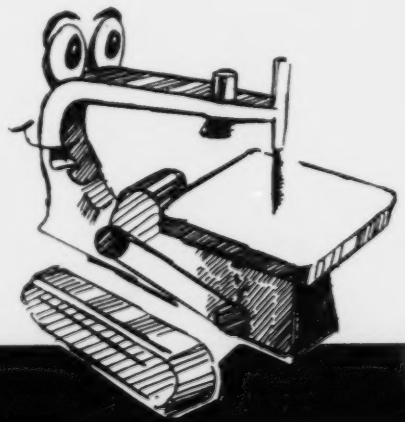


Goal 5

Gain an understanding of the physics of structures and their importance in technology.

Objectives:

- describe the different types of structures and their role in history.
- apply scientific and mathematical principles to the structure they are mod eling.
- describe hi-tech structures in use today and their application in the future.



PROBLEM SOLVING WORKSTATIONS

Vocabulary:

Structure
Beam
Compression
Strut
Tension
Tie
Strength Ratio
Triangulation
Lamination
Shear
Torque
Symmetry
Suspension
Truss
Cantilever
Post & Beam
Arch
Lentil
Geodesic Dome

Integrated Subjects

-Structure Physics/Science
-Research/Language Arts
-History of Structures
-Mathematics-Measurement
Specifications
Analyzing
Formulas
-Art - Construction Modeling
-Making

Equipment & Materials:

Apple IIe Computer System

Mouse & Mouse Pad

Imagewriter Printer

2 - Balsa Wood Razor Chopper

2 - Hot Glue Guns

Structure/Bridge Tester

2 - Portable Drawing Boards

3 - Various X-acto Knife Kits

Various Stick Balsa 1/8, 1/4, 3/8

Various Sheet Balsa 1/8, 1/4

Light String

1/8" Aluminum Rod

Various Dowel Rod 1/8, 3/16, 1/4, 3/8

Software:

Bridgebuilder

Design your own home series:

Architecture

Interior Design

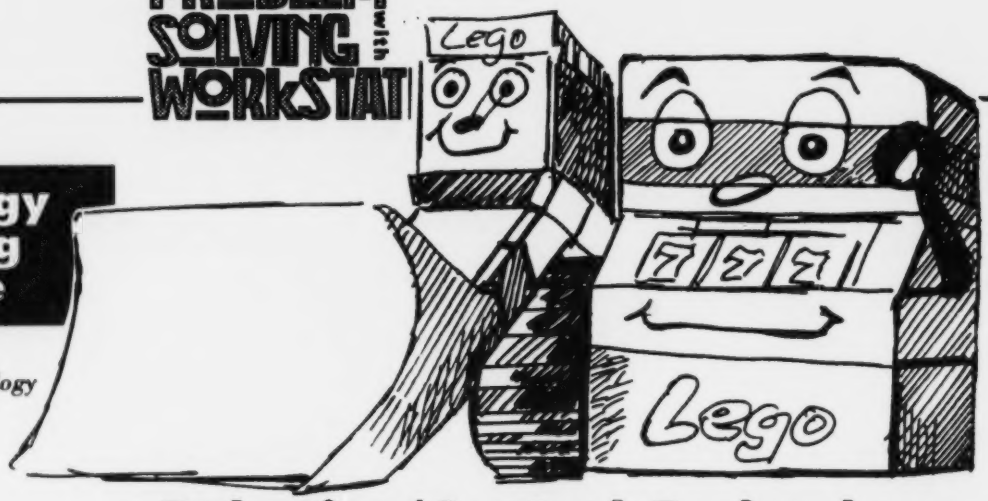
Landscaping

Mousepaint

Resources & References:

- **Structures and Forces.** MacDonald Educational Ltd., 1972.
- **Modular Courses In Technology: Structures.** Oliver & Boyd, SCDC Publications, 1987.
- **Construction Technology.** Huth, Mark W., Delmar Publishing, Inc., 1989.
- **Structure & Materials.** Whyman, Kathryn, Gloucester Press, N.Y., 1987.
- **Designing Houses.** Walker & Melstein, The Overlook Press, N.Y., 1979.
- **Unbuilding.** Macauley, David, Sandpiper Houghton Mifflin Books, Boston, MA, 1980.
- **Inventions,** The Patented Works of R. Buckminister Fuller. St. Matins Press, New York, 1983.
- **Home Playgrounds.** Mohr, Merilyn, Harrowsmith Publishers, 1987.
- **The Pitsco Bridge Book.** Carol, Rhonda, Pitsco, inc., 1989.
- **Science World.** September 9, 1988, pp. 10-15.

PROBLEM SOLVING with WORKSTATION



Robotics/Control Technology

Technology Learning Module

TLM Title:
Robotics/Control Technology

TLA Title:
Lego/Logo design

Grade Level:
7-8

No. of Days:
3 weeks

Primary Concepts:

- Design/Problem Solving Process
- Gear Train Design
- Mechanical Advantage Calculations
- Systems Design
- Computer Control & Interfacing
- Computer Programming
- Sensor Feedback Control

Activities

- Build a Mechanical Advantage Machine
- Program various Lego devices
- Your own Lego creation controlled by a program you write

Overview & Justification:

One of the characteristics of technology is how quickly it can change. This means that Technology Education must teach for tomorrow using tools and equipment which did not exist a few short years ago. Computer controlled robotic devices have resulted in new approaches to manufacturing, including computer-aided manufacturing (CAM) and flexible manufacturing, in which computer control of resources makes possible the fabrication of small lots conforming to special requirements.

Computers have also been used with scale models and simulation programs, resulting in more efficient designing and planning processes. This has created more economical and improved products for today's competitive international marketplace. For the foreseeable future, computers will continue in their significant technological roles. Today's technology education curriculum must include computers as a major component in order to train students for tomorrow's jobs.

Lego TC Logo enables students to control motors and lights and to monitor sensors in models built with lego elements. One of the features of Lego TC Logo is its use of procedures (short programs). With procedures, it is possible to break computer control tasks into small simple subtasks. Model making with Lego building components involves students in analyzing simple machines as gear trains are built and mechanical gear ratios are calculated. With Lego Logo activities students learn about technology while they practice hands-on problem solving and cooperative group work.

Goals & Objectives:

Goal 1

Develop an understanding and application of mechanisms and mechanical control.

Objectives:

- design and build mechanism which change input and output force direction using simple and complex machines.
- design and build devices which use gears, cams, pulleys and motors to change speed, torque, direction of rotation, covert rotary motion to linear motion or time a mechanical action.
- apply mathematical and scientific principles to calculate the mechanical advantage of a device you have modeled.
- apply designed models to the open loop model of the systems outline and explain how each component functions to complete a system.

Goal 2

Develop an understanding of electrical/electronic control as it relates to the feedback component of the systems model.

Objectives:

- identify the various electrical and electronic devices that can offer feedback in a controlled system
- apply electrical/electronic feedback devices to your model for control when testing your system.
- describe how electrical/electronic devices add control/feedback in everyday devices.

Goal 3

Develop an understanding of the basics of pneumatic and hydraulic principles and how to use them for control.

Objectives:

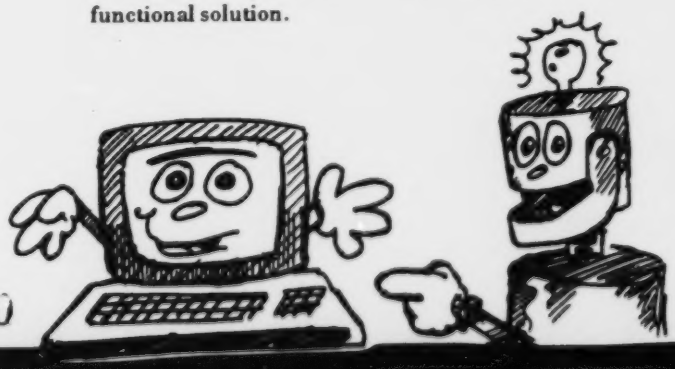
- develop knowledge to identify various pneumatic and hydraulic system components.
- develop knowledge to design and use pneumatic and hydraulic systems for control.

Goal 4

Develop an understanding of computer control and how everyday technology can be controlled using the closed-loop system of feedback for automation.

Objectives:

- demonstrate an understanding of the different computer control systems and how they can be used to allow a system to operate automatically.
- develop a working knowledge of the programming language used for control and explain how it will allow control of your system.
- decide upon a computer control problem and employ the design process to reach a satisfactory and functional solution.

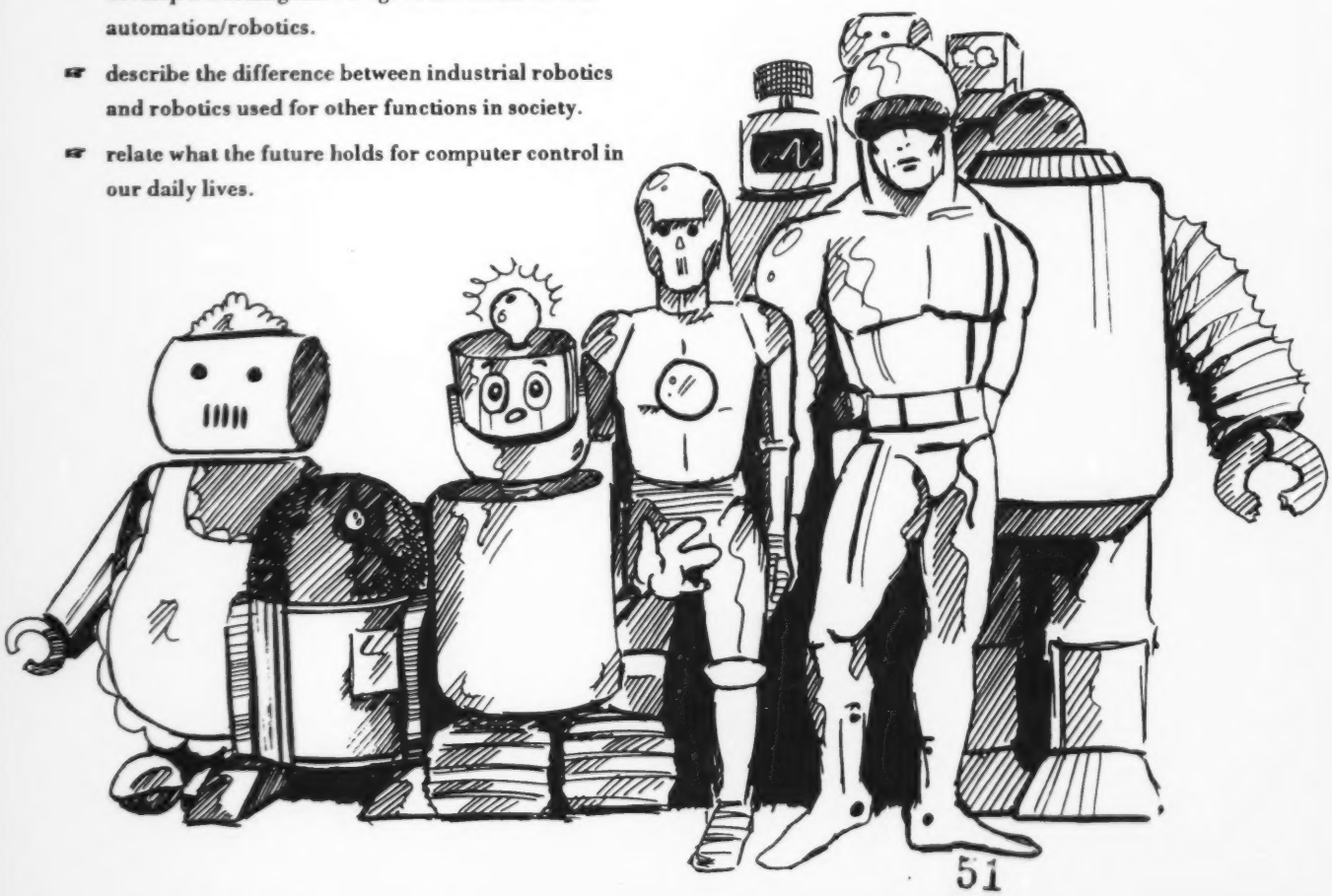


Goal 5

Describe the history and evolution of automation and robotics as it relates to control technology.

Objectives:

- clarify the difference between the fiction and truth of robots.
- trace the evolution of automation and robotics from the earliest form to the present.
- develop a working knowledge of the terms used in automation/robotics.
- describe the difference between industrial robotics and robotics used for other functions in society.
- relate what the future holds for computer control in our daily lives.



PROBLEM SOLVING with WORKSTATIONS

Vocabulary:

Robotics
Gear Ratio
Gears/Pulleys
Torque
Mechanical Advantage
Drive Gear
Interface
Driven Gear
Systems Analysis
Gripper
Sensor
Controller
Programming Language
Automation
Artificial Intelligence
Bionic
Android
Yaw
Cyborg
Pitch
Numerically Controlled Machines
Roll

Integrated Subjects

-Physical Science Concept
-Simple Machines
-Mathematical Calculation
-History of Robotics & Automation
-Research and Language Arts
-Computer Science & Programming Logic
-Artistic Illustration & Technical Drawing

Equipment/Resources:

2 ea Apple IIe Computer Systems

2 ea Lego/Logo Starter Kits

a. **Interface Box**
b. **Slot Card**
c. **Program**
d. **Lego Building Block Kit**
e. **Teacher's Manual & Student Booklets**

6 ea Lego/Logo 1090 Building Kits

Resources/References:

- **Technic Control, Resource Guide, Lego Dacta, 1991.**
- **Robots and Computers, Hawkes, Nigel, Franklin Watts Publishing, 1984.**
- **Computer-Controlled Robots; Potter, Tony. Usborne Publishing, 1988.**
- **Robots; McKie, Robin, Price/Stern/Sloan Publishers, Inc., 1987.**
- **The World of Lego Toys; Wiencek, Henry, Harry N. Abrams, inc. Publishers, New York, 1987.**
- **The Robot Book; Pawson, Richard, Francis Lincoln Limited, 1985.**
- **Living with Technology, Hacker-Barden Delmar Publishers, 1988.**

Technology Learning Module

TLM Title:
Graphic Communications
TLA Title:
Computer Graphics
Grade Level:
7-8
No. of Days:
3 weeks

Primary Concepts:

Design/Problem Solving Process

Computer Aided Drafting & Design

Computer Art

Systems Design

Desktop Publishing

Computer Multi-Media Presentation

Graphic Art

Activities

-Computer Aided Technical Drawing

-Computer Designed Poster

-Desktop Publishing Newsletter

-Multi-Media Presentation

Computer Graphics

Overview and Justification

Computer graphics are everywhere: In arcade games, on home computers, in films and on television. You have probably seen lots of computer graphics without even realizing it. Computers can be used to create those images as well as completing very detailed technical drawings to scale or fully animated multi-media productions. This particular work station explores what computer graphics are, how they are created and their applications. Students have the experience of creating many computer-generated graphics as they become the designer for a presentation project. Students follow the design process and learn the many ways of importing graphics and pictures into the computer for use and manipulation while designing the presentation for their final work to the classroom audience. Many communication techniques learned are applicable to each students design portfolio which they develop to present their results from each of the other work stations. There are three different types of activities students complete in computer graphics; Computer Aided Drafting, Desktop Publishing and Multi-Media Presentation.

Computer-aided Drafting (CAD) has become one of the most important modeling tools used by engineers, drafters, and designers. Using a CAD Workstation, a designer can create very precise drawings. The drawings can then be stored in the memory of the CAD system. CAD drawings can represent mechanical parts, electronic circuits, architectural blueprints, or many other designs. CAD has made drafters, designers, and engineers much more productive. With CAD they can spend more time doing mental design work and less time doing actual drawings.

Desktop Publishing describes the link up of a personal computer, special software, a mouse, and a high quality printer. The result of this combination is a page of text and graphics of very high quality. Desktop Publishing lets you arrange words and the pictures on the computer screen exactly the way you want them to appear on paper. Many companies are now using Desktop Publishing to prepare their own newsletters and advertising brochures.

Multi-Media, also known as media integration is the blending together of still pictures, moving pictures, written words, spoken words, sound and music into

one seamless presentation. You can't open a computer magazine these days without seeing a reference to mutimedia. Today multi-media has exploded into a wide variety of applications ranging from educational lessons to various types of computer video presentations. One of the more common type of projects students like to take on is the mix of video and computer, where they video tape something, say a sports event, then use a computer to edit, add titles, sound, and splice it all together for a video presentation. The resulting sense of pride among student authors is amazing. It is one thing to "publish" for your teacher's work folder or your family's refrigerator door. It is something else again if your "presentation" is an electronic slide show that the administration displays in the school office, or a movie that the teacher shows to parents on orientation night.

Performance Objectives:

Goal 1

Solve problems using the tools, machines, processes, products and services of industry and technology.

Objectives:

- create computer graphics through the design process using resources similar to those used in industry.
- use various methods to input graphics to the computer such as: clip art libraries, scanners, video digitizers and computer drawing tools.
- use various techniques to present work, including printers, plotters, computer screen, TV monitor and computer slide presentation.

Goal 2

Progress through a series of distinct steps that are part of the design problem-solving process.

Objectives:

- perform the act of researching all pertinent information as it relates to visual design elements and principles.
- create a design brief stating a specific purpose with criteria for evaluation
- generate solutions in the form of "thumbnails" which explore and compare concepts.
- produce a rough draft on the computer to evaluate and refine preliminary ideas.
- complete a finished product which will be scrutinized by a group critique judging effectiveness.

Goal 3

Students will identify and describe the history and evolution of the computer as a technological tool.

Objectives:

- demonstrate an understanding of the important events that brought the computer to its level of importance in the information age.
- identify the names of technologists who pioneered the computer revolution.
- relate an understanding of the computer as a technological tool in today's information society.
- extrapolate the future of the computer in a technological society based on its impact today.

PROBLEM SOLVING WORKSTATIONS

Vocabulary

Design Brief
Thumbnails
Graphic Art
Rough Layout
Commercial Art
Comprehensive Layout
Type Set
Camera-Ready Art
Balance
Computer System
Proportion
Hard Drive
Contrast
Vacuum Tube
Harmony
Transistor
Unity
Integrated Circuit

Integrated Subjects

-Computer Applications
-Computer Art
-Visual Design
-Computer-Aided Drafting
-History and Evolution of Computers
-Language Arts & Research
-Mathematical Scale & Measurement

Equipment/Materials Needed:

CAD Activity

One IBM computer system

286 CPU 40 meg hard drive

VGA monitor

mouse

color printer star rainbow

color plotter HP color pro

software - Design CAD

Rainbow paint

Desktop Publishing

One Mac LC computer system

40 meg hard drive 5 1/4 disk drive

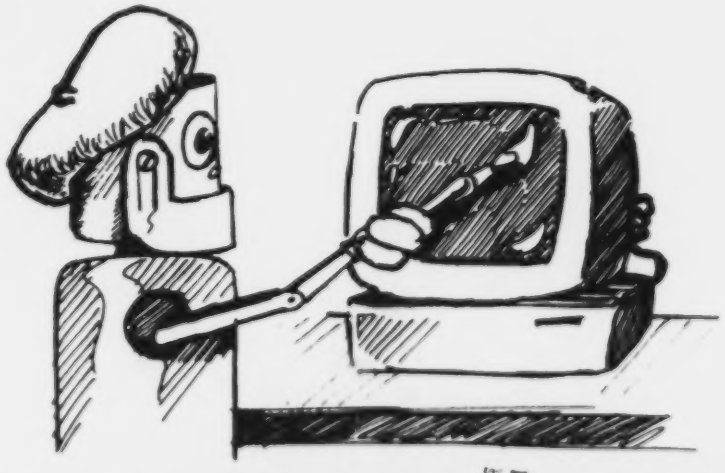
4 meg memory 3 1/2 disk drive

color monitor

HP ink jet paintwriter

software - Page Maker 4.0 Easy Paint

Microsoft Works Super Paint



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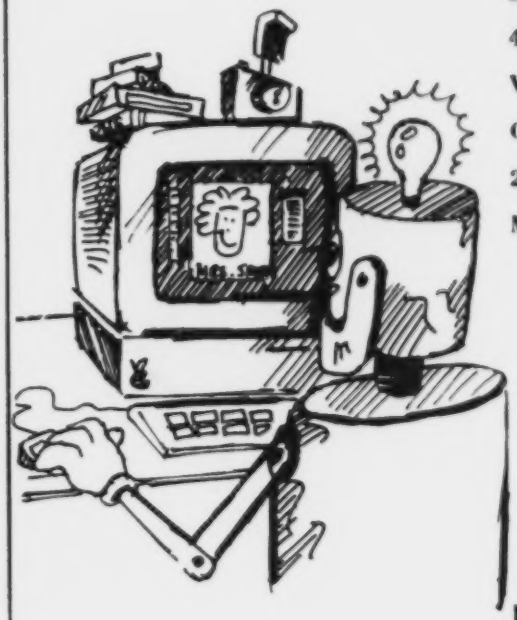
PROBLEM SOLVING WORKSTATIONS



Multi-Media

Apple IIGS computer system

20 meg hard drive

4 color Imagewriter II printer

VCR Video over lay card

Camcoder Heavy duty tripod

21" Color TV/Monitor Panasonic

Multi-Media software

- **Hyper Studio**
- **Video Mix**
- **VCR Campanion**
- **IIGS Print Shop**
- **IIGS Print Shop Companion**
- **Deluxe Paint**
- **Platinum Paint**

Resources/References:

- **Getting the Message - The Technology of Communication, DuVall, Maughan & Berger, Davis Publications, Inc. 1981.**
- **Computer Graphics, Talchell & Howarth, Usborne Publishing Ltd., 1983.**
- **Living With Technology, Hacker & Barden, Delmar Publishing, 1988.**
- **Encyclopedia of Computers, Rand McNally & Co., 1983.**

Magazines - *special issues for preview

- **A+ Incider - November 1991**
- **T.H.E. Technological Horizons in Education January 1989**
- **Classroom Computer Learning - October 1989 and November 1989**

Workstation Implementation Strategies

The implementation of technology problem solving workstation requires serious planning and a large amount of set up time. It is best attempted by an experienced technology teacher who has spent time refining technology learning activities with various projects. Once the stations are implemented the teacher will find they will evolve on their own with student and teacher involvement.

The setting up of the environment is of crucial importance to the success of the project. Stations must be of high interest, high motivation for all students with consideration taken as to student interests and attitudes. Many young girls are turned off by projects such as mag-lev cars or bridges yet become enthusiastic designers of futuristic clay vehicles or scale model playground structures. It is of importance that there are many available choices so that students can feel a sense of ownership with their activity. Experienced technology teachers have at their grasp many highly successful activities that they can draw upon form past years. If you desire, and I recommend it, let your students and yourself get caught up in the experimental stages as you all try to perfect your activities selection.

Of prime importance is to have just the right amount of information at each station. You want to set activity guidelines for student discovery; not step by step instructions like a cook book recipe. Student handouts give problem background information and specifications for activity. Some handouts are required as worksheets guiding students in the proper steps of the design process. Bulletin boards at each station shows examples of acceptable work and design possibilities. Many examples of students previous work are displayed to highlight creative designs.

Computers play an important role at workstations. We live in a computer age and no one knows this better than young students. To many, technology and computers are synonymous. Computers help to motivate and entice this generation of video kids as they have grown up living with this highest of technologies. Computers at the workstation play many roles. At structures they allow student engineers to design a bridge and complete a structural analysis of its strength in a strength simulation. At the transportation station students work with an interfaced windtunnel and mag-lev track which controls operation and

displays design results. Lego projects are controlled by logo programs students write as electronic sensors send information to the interfaced computer for further instructions. Students gain valuable design and computer application skills at the graphics station. Here state of the art computers challenge students to design desk top published newletters, CAD designs and multi-media presentations.

Most of all implementation of problem solving workstations takes the whole hearted effort of a dedicated technology teacher. There are various programs around the country to study for ideas. Programs such as the Trans-Tech Lab 2000 or the Pitsco Synergistic system are packaged programs and offer various workstation modules for classroom implementation.

PROBLEM SOLVING with WORKSTATIONS

Technology Lab Environment

1. Workbenches:

Work area centrally located for project proto-type development

Five 5'x5' maple top workbenches

Four woodworking vices on each corner

Storage locker underneath

2. General tool locker:

Locking storage cabinet housing

Required general hand tools and machines used in project construction

3. Machine area:

Spacious well lit area for general machine work

Well ventilated with non skid floor area

Safety instructions and safety guards at each machine

4. Finishing area:

Finishing - Paint locker with various types of finishes for students models (non-toxic, water based paints are based)

Spray booth to draw hazardous fumes outside of lab environment

5. Reference/Research area:

Large wall shelf area displays various media for student reference use

Books, magazines, videos and software allow for student research and information gathering

6. Display area:

Hallway showcase outfitted with electricity to display students' work to others and a display shelf in the lab to showcase completed work waiting teacher evaluation

7. Clean up station:

Sink
Eyewash
Paper Towels
Rags
Dustpans
Brooms
Furniture Polish
Soap

8. Teacher Storage:

Various under bench lockers around lab

8'x25' lockable room for storage of supplies, equipment, teaching aids, repair equipment and large student projects

Finish locker non-flammable, heating units and lab electrical-electronic controls

9. Teachers Office 8'x8'

File cabinet, work desk or counter, personal locker, phone, computer and fax, bookshelf for personal collection

The environment of the middle school technology lab using any approach is very important as it sets the mood and reflects the kind of education going on inside. The technology lab should be different from industrial arts shops of the past, representing more of a high-tech research and design lab than a factory setting. The colors of walls, machines, lockers, tables and other furniture should be colorful and the room alive with active, bright, and creative posters, pictures, paintings, bulletin boards, sample project shelves and inspirations. Soften the area with plants, sculptures, furniture and lighting. A tile floor for the computer area, a carpeted resource area, and a wooden floor work area sets zones of work with different moods.

An exterior double door to the outside aids for students testing of solar devices, weather testing devices, flight testing and many other functions

Student Evaluation

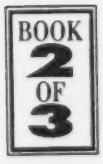
The evaluation of a student's progress and the assignment of a final grade is difficult in the best of programs. In a technology education course employing problem solving workstations the task becomes even more difficult. Because one of the major goals of the program is the development of the ability to use the design/problem solving process to solve technological problems, the assessment of students cannot be limited to judging finished projects or the memorization of facts. Allowance must be made for assessing students' use of the design process and the ability of the student to apply the process to new situations.

The production of a student portfolio or documentation is very beneficial in that it demonstrates the design/problem solving process the student has employed. This portfolio carries half the weight of the students workstation grade. An evaluation instrument developed by the Commission on Technology Education (COTE) is a valuable tool for both the student and teacher in evaluation of the documentation. an important aspect of the documentation is that the student has evaluated themselves noting successes as well as downfalls. Suggestions should be made as to how the project could be made better or modifications or alterations which would ensure a successful conclusion.

The project itself is graded in four different areas of equal weight. Students' projects are evaluated to see if all the criteria and specifications set in the Design Brief have been met or not. Of equal importance is the craftsmanship of the project, always stress that quality is number one in the classroom as habits formed now are for a lifetime. Students' creativity of design and creativity in use of materials and equipment is also evaluated and encouraged throughout the activity. Last but of equal importance is the consideration of the complexity of the task attempted appropriate to the time allotted. It is best to have student evaluate their work first as their honest thoughts tend to be right on track. This form of project evaluation I call the four C's:

1. Criteria
2. Craftsmanship
3. Creativity
4. Complexity

Evaluating projects in this manner seems to be very thorough and fair.



All artwork, (design, typesetting &
illustration) by Jon Paul LaMonaco

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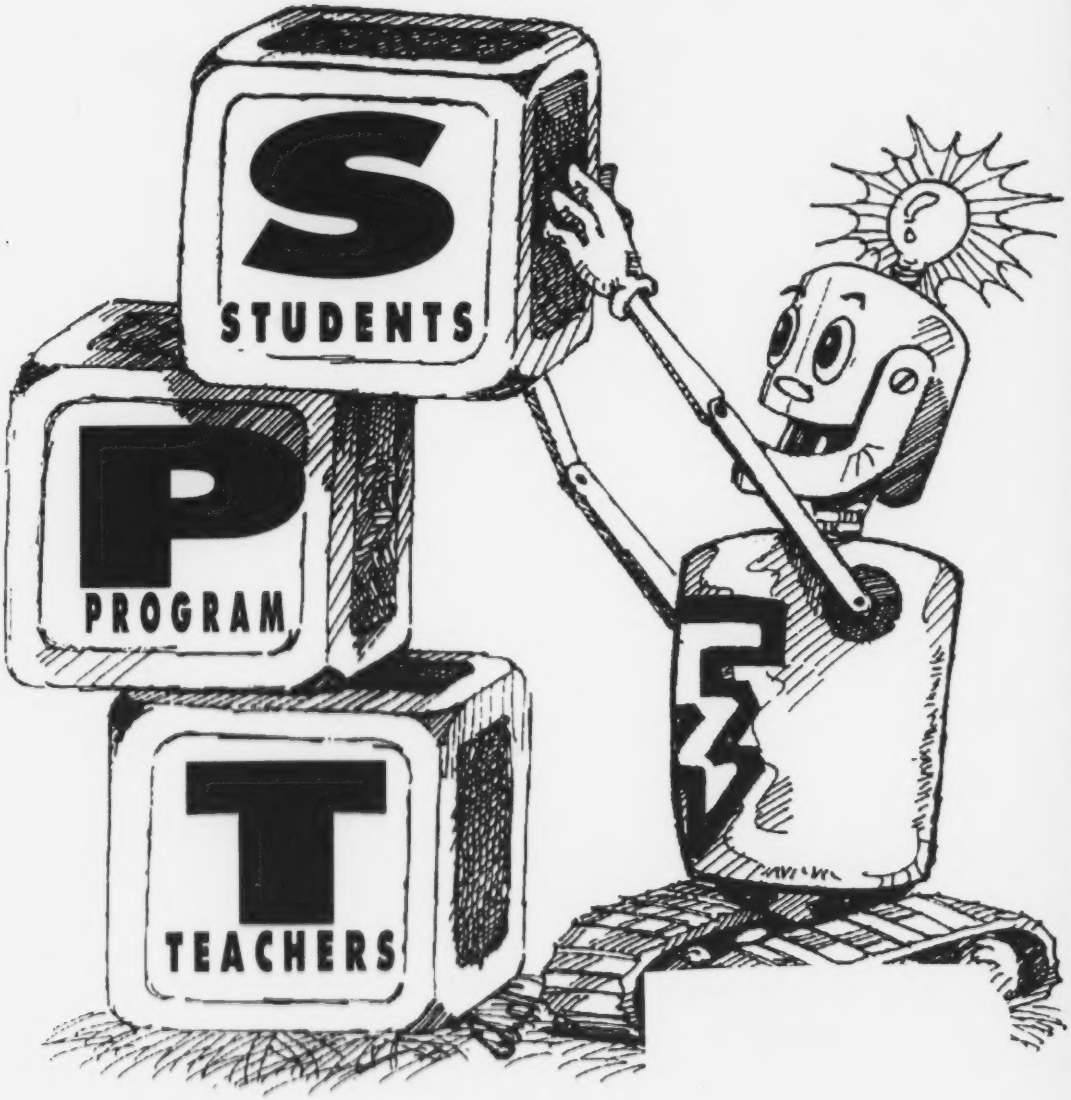
TEACHER DEVELOPED TECHNOLOGY

TD - TEN

EDUCATION FOR THE NINETIES

STUDENT INFORMATION



PROBLEM SOLVING with WORKSTATIONS

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PROBLEM SOLVING WORKSTATIONS

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Designing with Structures
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Computer Graphics

Student Worksheets Samples

1. *Lego-Logo worksheet*
2. *Structures Evaluation*
3. *Glide path worksheet*
4. *Car modeling sketch sheet*
5. *History of computer worksheet*

This project was conducted pursuant to a contract from the New Jersey State Department of Education, Division of Vocational Education and was 100% state funded under the State Income Tax Revenue Account. Monies in this account are appropriated through New Jersey Statutes Annotated, Subtitle 7, State and Federal Aid to Schools, Section 18A:58-34 and 35. The contractors undertaking this project were encouraged to express their judgement in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official funding agency positions or policies

Technology Workstations

Following are descriptions of workstation activities that you could possibly complete. Carefully read through each description and select the activity you will work on. At the stations you will find additional information which relates to your selected activity. Use the student worksheets to guide you through each step and make sure the teacher checks and OK's completed steps.

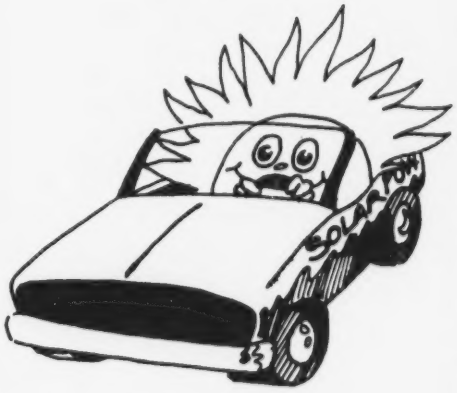
VEHICLE TRANSPORTATION

AT THIS STATION YOU ARE TO COMPLETE THE FOLLOWING:

1. A computer simulation of a vehicle.
2. A technical drawing illustration of a vehicle design.
3. A model prototype of a vehicle design.

Criteria

1. Follow the design process and provide documentation.
2. Complete station work within a (3) week time period.
3. Have all project ideas approved by the teacher.
4. Work individually or in a team.



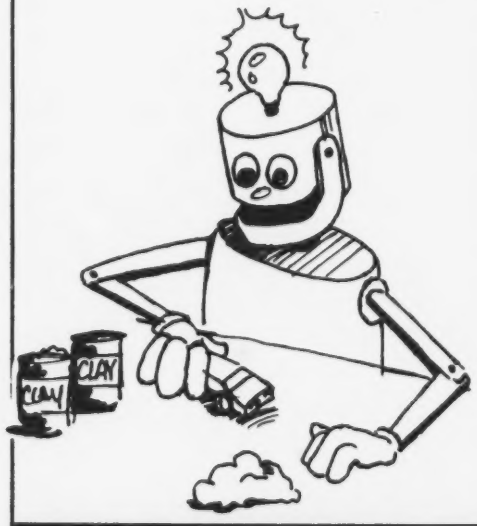
POSSIBLE ACTIVITIES

1. Magnetic Levitation Vehicle:

The goal is to design a mag-lev vehicle to traverse a 8' track in the shortest period of time. This design allows contestants to draw electricity from the tracks side rails via electrical wires attached to their vehicles. Power to the track is turned on by the computer which also times the vehicles elapsed time.

2. Solar Vehicle:

Design and build a car powered by the energy source of the future, the sun. Solar cells power a sensitive electrical motor to turn gears and pulleys as your cars wheels move under the force of free energy. A great science project that has won competitions.

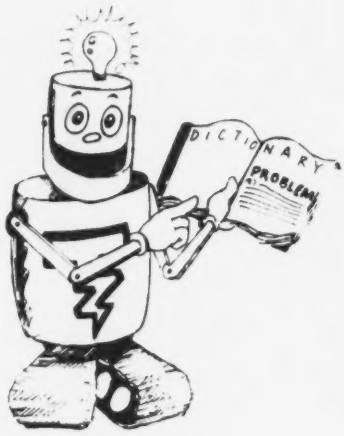


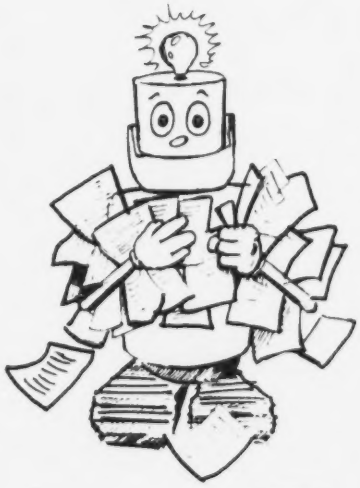
3. Futuristic Clay Car Design:

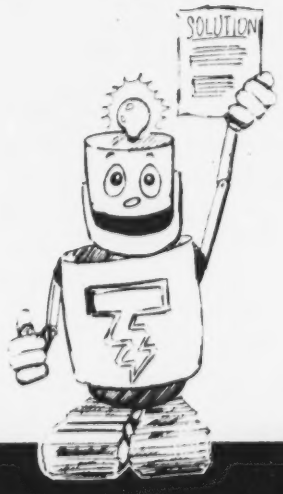
Put your artistic talents to work as you sculpt a hunk of clay into a beautiful masterpiece. Use multi-colored clays to design a streamlined automobile of the future and test its aerodynamics in the wind tunnel.

4. Computer Simulations:

A. Car Builder - Design a modern day car on the computer by choosing from a wide assortment of body styles, engines, tires, suspensions, transmissions and much more. Then test your car design on a computerized wind tunnel and a computerized road track. The computer analyses the results and tells you of any design problems. Give it your best at beating the teachers.







B. Sunraycer - Participate in a solar car race held in the outback country of Australia. You race other cars entered in the World Solar Challenge traveling 1,950 miles from Darin on the northern coast to Adelaide on the southern coast. Along your computer solar journey you will explore topics including energy production inside the sun, conversion of light into electricity by solar cells, minimizing drag and friction for energy efficiency and vehicle design.

Steps in Vehicle Design Activities

Steps in the design of transportation slides follow the Design/Problem Solving process learned in class.

1. Defining the Problem:

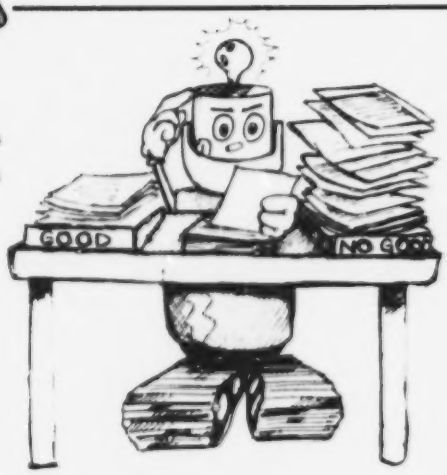
Look over the possible areas of work and select an activity that you or your team want to work on. Review the bulletin board for possible project ideas, check out the projects other students have complete for ideas and look through student handouts for further information. Next write a Design Brief which states exactly what you the designer will do and list specifications as to what the solution should do.

2. Information Gathering:

Gather information to increase your knowledge about the topic you are dealing with. Start with reading related student handouts and magazines at the station. Also, each station has videos offering information on design and real world applications. The class resource area has further information as well as the library. At this stage you should identify what materials and equipment are available for your use. you would take notes are write down all pertinent information for your documentation portfolio.

3. Develop Solutions:

You should develop many ideas that you could use for your design. The technique of brainstorming allows you to write down numerous possible ideas or sketches without evaluation their effectiveness yet. Looking at what others have done may spark your own original idea or combining many different ideas into one may offer something special. Ask others for suggestions or look in the resource area for ideas. Remember, always sketch ideas down and include in your documentation portfolio.

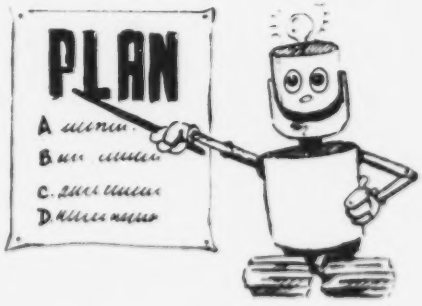


4. Evaluate & Select Best Design:

Evaluation of ideas for selection is a critical step. Match up designs with the specifications set forth in your Design Brief. Criteria for a design should include:

a. Does the design meet the set criteria
b. It is a creative, original design
c. Can I complete this design in time given
d. Are materials available for this design
e. Are the tools and equipment available
f. Is the design to complex and liable to have problems

In the selection of your design it is always better to choose a simple design and do a good job at it than to choose a complex design that never turns out right. Write reasons for selection in your documentation.



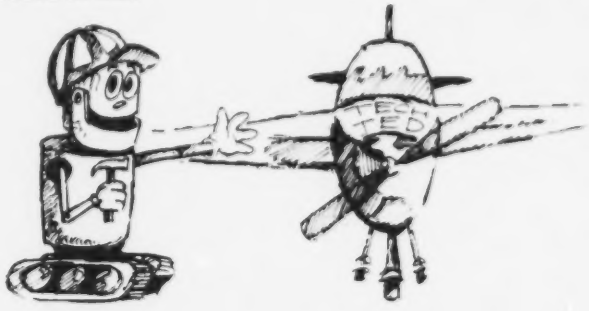
5. Develop a Set of Plans:

A set of plans include three (3) items:

a. A technical drawing- draw a full size drawing of your side, top and end view. Include all details and be very neat.

b. A material list - write a detailed listing of each individual piece of material and accessories you will need to complete your project.

c. Steps and procedures - write down each step you will take in building your model and include tools and machines needed in that step.



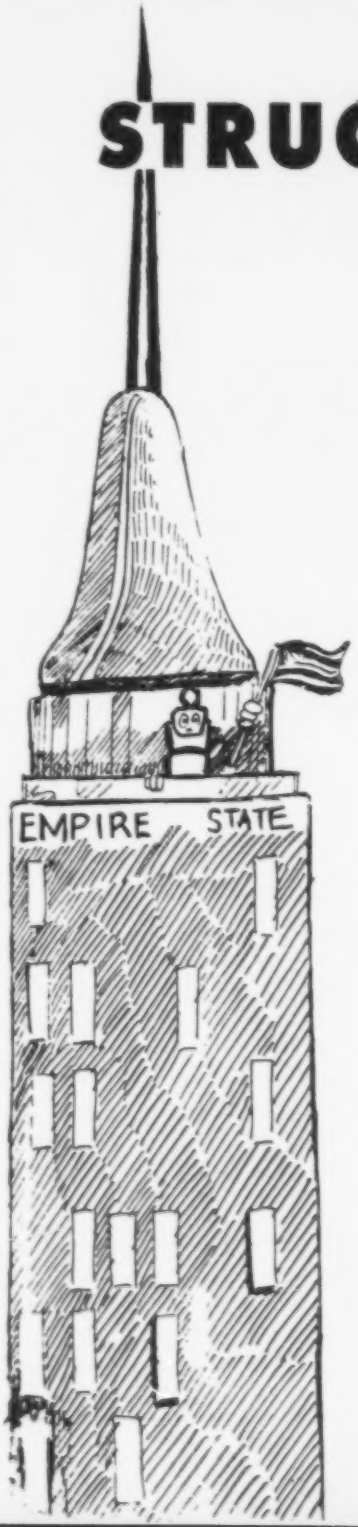
Basic steps include:

1. *Layout - measuring and marking material*
2. *Cutting - separating material from larger stock*
3. *Shaping - forming the material into desired shape*
4. *Assemble - putting together of different parts*
5. *Finish - sand, smooth and paint*

6. Construct Project:

If you have done all previous steps this part is easy and fun. Take it slow and make sure you follow safe work habits. Know what you are going to do each day you come into the lab. Have a goal to accomplish! Do not waste material. After you are done for the period, clean up your work area, put your project away and help with a general cleanup.

STRUCTURE MODELING



7. Testing of Solutions:

Actually, testing goes on often during project construction to see how certain steps are coming along. You can wind tunnel test designs for aerodynamics, test mag-lev vehicles on the magnetic-powered track, or test solar powered vehicles on a solar track. Write all results and modifications necessary in your documentation.

AT THIS STATION YOU ARE TO COMPLETE THE FOLLOWING:

1. Design and build a structural model.
2. Complete a technical illustration of a structure.
3. Apply the computer to a structure project.

Criteria

1. Follow the design process and provide documentation.
2. Complete station work within a (3) three week time period.
3. Have all project ideas approved by teacher.
4. Work individually or in a team.

POSSIBLE ACTIVITIES

1. Balsa Compression Structure:

Design and build a structure using only 48" of balsa wood to protect an egg from 25 pounds of weight applied atop the structure.

Criteria:

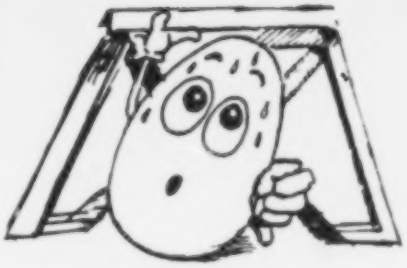
1. raw large size egg placed under or inside structure
2. steel plate weight balanced atop balsa structure
3. use only 48" of 1/8" x 1/8" balsa wood
4. can use up to 18" of thin string supplied
5. use white Elmers glue

2. Truss Bridge Competition

Design and build a balsa wood bridge to enter into the finals for the New Jersey state competition.

Criteria:

1. follow Technology Student Association guidelines
2. use only 1/8" x 1/8" balsa wood strips
3. test on bridge tester in Technology Lab
4. design for 14" span
5. use red colored woodworking glue



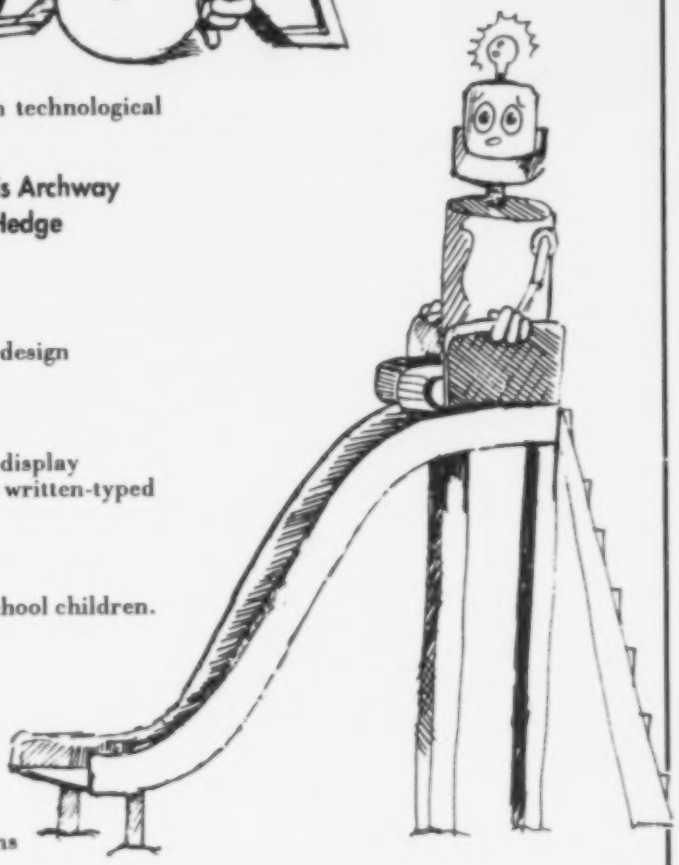
3. Historical Structure:

Design and build a model of a historical structure with technological importance. *Examples:*

Eiffel Tower	Golden Gate Bridge	St. Louis Archway
Empire State Building	Hoover Dam	Stone Hedge
Pyramid of Phavols	Panama Canal	

Criteria:

1. model should be a scaled replica of original structure design
2. scale model should not exceed 24" in size
3. can use any materials available in Technology Lab
4. structure model should be assembled in the form of a display containing (1) model, (2) drawing/illustration, and (3) written-typed description



4. Playground Design Model:

Design and build a scale model of a playground for preschool children.

Criteria:

1. design for preschool children 2-5 years old
2. model to be built to 1/12 scale
3. model can be built of any material in lab
4. playground design should be ergonomically correct
5. playground model should include safety considerations

5. Deck/Outdoor Structural Model:

Design a deck or gazebo for your own home and build a model of it.

Criteria:

1. design and model should be designed for your own home or yard
2. model to be 1/12 scale in size
3. model to be built of balsa wood and other modeling materials
4. design specifications should include cost of structure
5. model specifications should include construction techniques such as foundations, framing requirements, and finishing techniques.

70

6. Futuristic House Design:

Design and build a model of a structure of tomorrow.

1. structure model should be 1/12 scale
2. scale model should not exceed 18" in size
3. model can be build of any material in lab
4. model design should include conventional construction techniques and regulations; examples: door size, room size, roofing requirements
5. model should include a finish such as paint

7. Computer Design:

You can also use the computer in conjunction with your structure project thus gaining an added dimension of what professionals really do in the world of work.

Software: Bridge Builder

Design a truss bridge on the computer to span a river valley and allowing an 80,000 Cb truck to cross over. Designs are analyzed and tested on computer and you can print out design and analysis.

Design Your Own Home

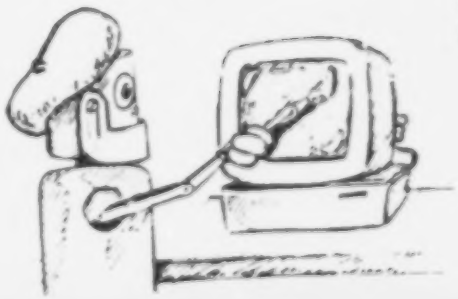
You can draw floor plans, side view building plans and structural details with ease to create the home of your dreams. A wide variety of scales, grids, shapes and lines give you everything you need to create a professional drawing or a single sketch.

Design Your Own Interior Design

Become an interior designer as you design room plans quickly and easily. Arrange furnishings and explore dramatic or subtle color schemes at the touch of a key.

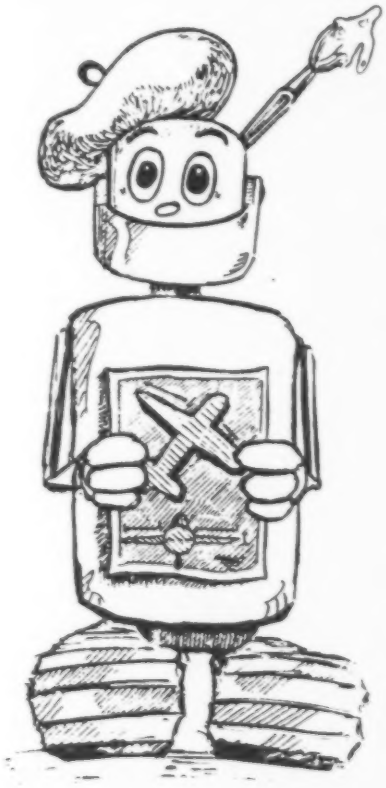
Design Your Own Home Landscaping

Enhance your property and living environment as you create the perfect outside landscaping design. You can identify and label plants and even "age" your trees to get an idea of what your landscape will look like years from now.



Steps in Design-Modeling

1. *Identify the problem you are going to work with and write a design brief with specifications.*
2. *Gather information to increase your knowledge about the problem to help you with your solution design.*
3. *Develop many possible solution designs by brainstorming and sketching thumbnail ideas.*
4. *Evaluate your ideas and select the best possible solution.*
5. *Draw up a set of plans including a technical drawing, material list, and steps and procedures.*
6. *Construct your project paying attention to details assuring high craftsmanship and quality work.*
7. *Test your solution and log results or explain how your solution would be tested and how yours would do.*
8. *Evaluate your work noting modifications needed to improve solution.*



LEGO - LOGO ROBOTICS

AT THIS STATION YOU ARE TO COMPLETE THE FOLLOWING

1. Build a mechanical advantage machine.
2. Program various ready made lego devices including a robotic arm.
3. Design and build a lego device that is controlled by a program you write.

Criteria

1. Follow the design process and provide documentation.
2. Complete station work within a (3) three week time period.
3. Have all project ideas approved by teacher.
4. Work individually or in a team.

ACTIVITIES

1. Build a mechanical advantage machine (gear train).

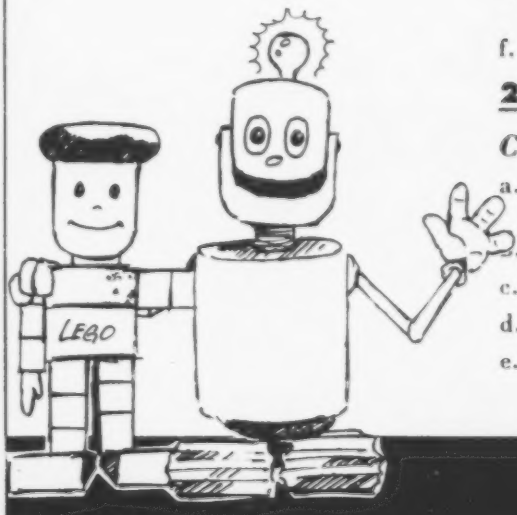
Criteria:

a. use no more than a combination of 8 gears and or pulleys
b. mechanical advantage calculated
c. gain a mechanical advantage of 10 or higher
d. complete a descriptive technical drawing of top and one side view
e. after completion of device hook up lego motor and test power of output shaft
f. answer questions at end of gearing/pulley handout

2. Program various lego devices.

Criteria:

a. program a traffic light to rotate through its sequence; green-yellow-red
b. program a car to move around on the work table
c. program a robotic arm to pick up and move a lego block
d. program a lego device to respond to a sensor
e. write down and explain all tested programs



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3. Design and build a device out of legos that is controlled by a program you write.

Criteria:

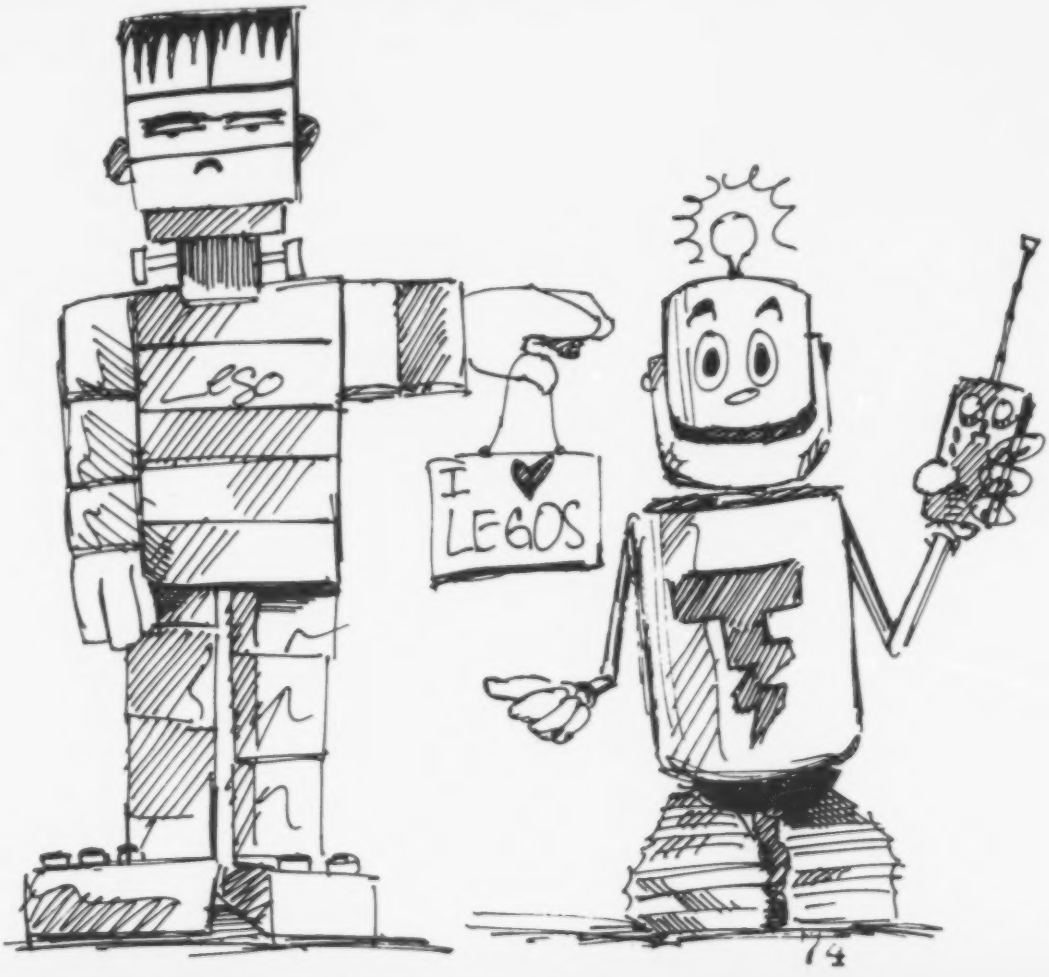
a. complete brainstorming worksheet to develop ideas.

b. lego device to include a motor and a sensor

c have project idea approved by teacher

d. if you are following lego booklet project idea modify to make it better – be creative

e. read handouts on robotics and answer questions at end.



COMPUTER GRAPHICS

AT THIS STATION YOU ARE TO COMPLETE ONE OF THE FOLLOWING

1. A computer aided technical drawing illustration (CAD drawing on the IBM computer system).
2. A computer aided poster (persuasion sign using the Print Shop software package with the Apple IIGS color computer system).
3. A newsletter (short 1-page newsletter mixing graphics and text on the Macintosh color computer system)
4. A multi-media presentation (combining computer work with camcorder recordings, sound digitizing, VCR recordings, on the Apple IIGS).

Criteria

1. Follow the design process and provide documentation.
2. Complete station work within a (3) three week time period.
3. Have all project ideas approved by teacher.
4. Work individually or in a team.

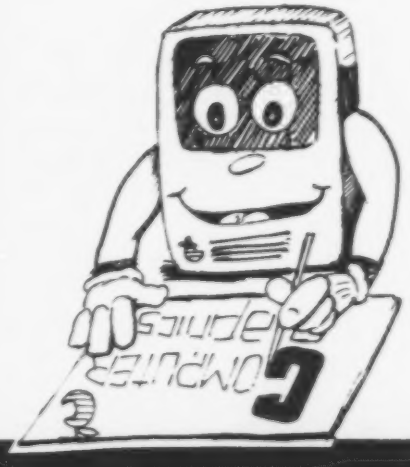
POSSIBLE ACTIVITIES

1. Computer aided technical drawing.

a. house design in color
b. bridge design to be built in structures station
c. deck design to be built in structures station
d. airplane/glider to be built in flight station
e. vehicle design to be built in transportation station
f. sports field design

2. A computer designed poster to persuade action.

a. lab safety poster
b. energy conservation poster
c. environmental awareness poster
d. drug awareness poster



3. Desktop publishing newsletter.

a. team newsletter
b. club newsletter
c. class newsletter
d. sports newsletter

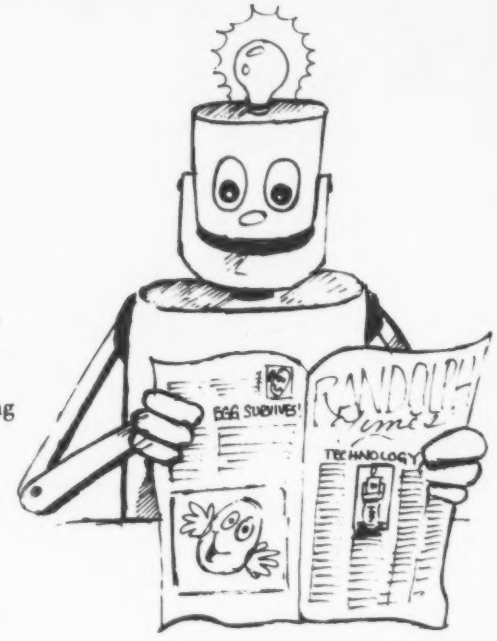
4. Multi-media computer presentation.

a. video tape a workstation in action and splice in computer graphics, text and digitized sound for a "professional production".

b. produce a sports home video combining all the best of your video clips to produce a "greatest of" video, combining computer work and video.

c. produce a documentary of all the teachers on your team, scanning their pictures into the computer, adding their voices to their pictures, and writing a little bit about them for a "TEAM DOCUMENTARY".

d. produce a "how to" presentation using a combination of the computer, VCR, sound digitizer, and camcorder for any class, club or sport.



STEPS IN COMPUTER GRAPHICS ACTIVITIES

Steps in the development of computer graphic design follows the Design/Problem Solving process learned in class.

1. Defining the Problem:

Look over the possible areas of work and select an activity that you or your team want to work on. Considerations for choice would include you interest in the activity, your knowledge about the equipment and the possibility of different solutions and designs for completion. Then write a Design Brief which states exactly what you the designer are going to do and list specifications as to what the solution is going to do. The listing of specs that the design solution should include allows you to evaluate a solution idea or evaluate your final work.

2. Information Gathering:

After a problem has been defined, the designer needs to gather information about the problem in order to solve it. It is here that we gain an understanding of the equipment available and what it can do. Also what software you will be using and how it works. Read the equipment and software manuals during these initial stages to gain a clearer understanding of proper procedures and various activity possibilities. You should read all available handouts for your station and take notes to make sure you know needed information.

3. Develop Solutions:

You should develop many solutions that you could use as a design for your activity. The technique of brainstorming allows you to write down numerous ideas or sketches without evaluating their effectiveness yet. Looking at what others have done may spark your own original idea or combining many different ideas into one may offer something special. Ask other people for their ideas or just spend time day dreaming about solutions. Remember always sketch ideas down, these rough, quick, small drawings are called thumbnails.

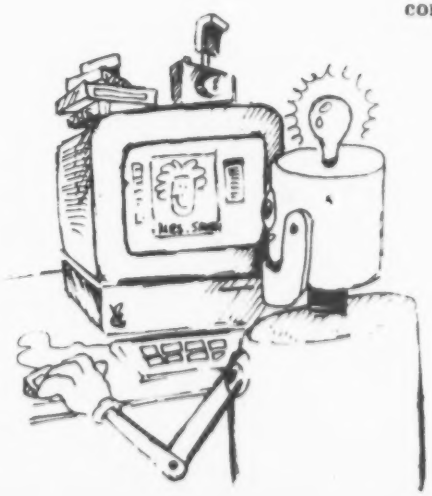
4. Choose the Best Solution:

You need to select the best design to use as your solution/project. One way of doing this is to list all the good and bad points of each idea and compare them. Another method of selection is to make a list of all the specifications which pertain to the solution. Across the top of the page you list your designs. Check off requirements and constraints and scoring each idea is a way of organizing data to evaluate ideas. Remember, a simple design well done is much better than a complex design gone astray.

5. Producing-Making the Project:

Now comes the fun and the frustration. If you have ever worked with computer before then you know what I mean. If not, then remember, computers have a mind of their own. Read their instructions.

1. List basic steps to go through
2. Save all computer work often and at the end of the period
3. Print out results often to see how it looks



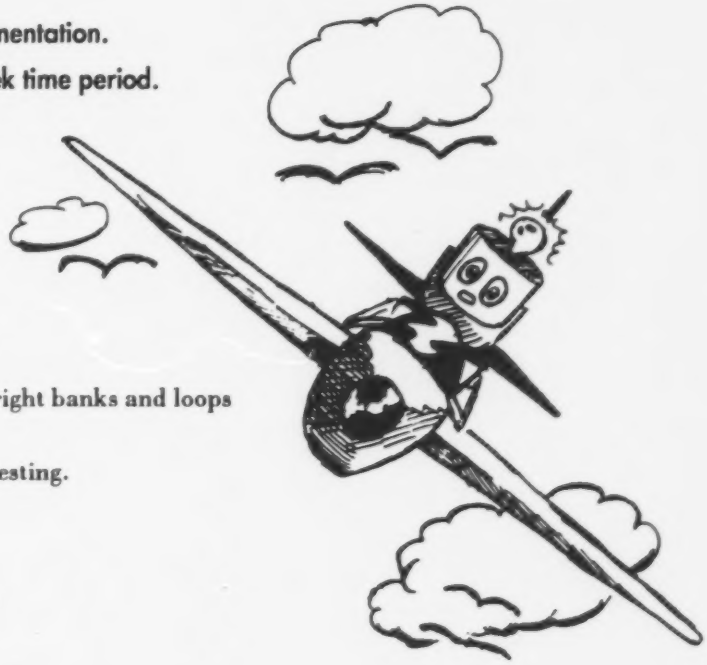
FLIGHT MODELING

AT THIS STATION YOU ARE TO COMPLETE THE FOLLOWING

1. A computer simulation modeling flight.
2. A technical drawing illustration of a flight design.
3. A model prototype of a flight design.

Criteria

1. Follow the design process and provide documentation.
2. Complete station work within a (3) three week time period.
3. Have all project ideas approved by teacher.
4. Work individually or in a team.



POSSIBLE ACTIVITIES

1. Balsa wood glider:

Design a glider to perform flight maneuvers.

Criteria:

a. maneuvers to include straight flight, left and right banks and loops
b. size not to exceed 14"
c. perform balance and wind chamber stability testing.
d. sand airfoil shape into wing
e. finish sand and paint glider

2. Rubber band powered airplane.

Criteria:

a. use thin balsa wood frame with tissue paper cover
b. size not to exceed 14"
c. airplane to remain airborne 30 seconds or more
d. use 4" plastic propeller and rubber band material in lab
e. perform balance and wind chamber stability testing

3. Model-prototype of futuristic SST design.

Criteria:

a. design can be flight worthy or non-flight design
b. use balsa wood, styrofoam and various craft materials in lab
c. test design in wind chamber for stability

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d. finish sand and paint prototype

e. size not to exceed 14"

4. Design and build a futuristic rocket.

Criteria:

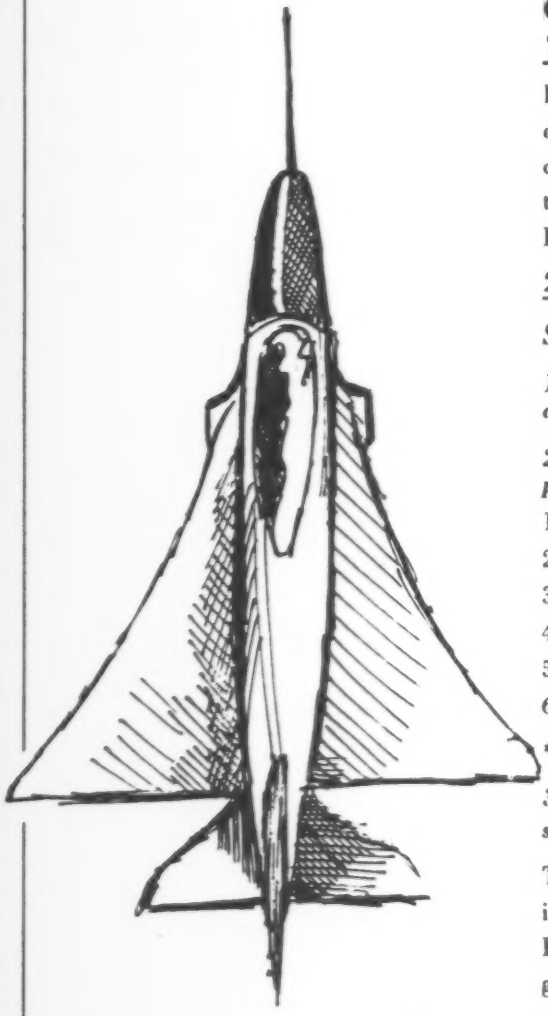
a. rocket to be launched using B-4 rocket engine

b. use rocket parts from Estes Rocket Designers kit

c. rocket size not to exceed 14"

d. test design in wind chamber for stability

e. launch rocket for final testing



COMPUTER PROGRAMS

1. Glidepath, glider design simulator.

Design a glider on the computer design board and test it over different landscapes. Program demonstrates how your glider flies over mountain terrain, lakes, oceans and desert conditions. You can then modify your design and re-test to try to perfect your design. Follow Glidepath Worksheet.

2. Flight Simulator II, pilot simulation software.

Steps in Flight Modeling

1. Identify the problem you are going to work with and write a design brief with specifications.

2. Gather information to increase your knowledge about your project. You can gain information by:

1. Reading student handouts
2. Studying Workstation bulletin boards
3. Reviewing magazines on flight in magazine rack
4. Read books in resource library in lab
5. View video tapes on flight on the VCR
6. Study computer software & simulations on flight

****Write down all information learned and resources studied.***

3. Develop many possible solution designs by brainstorming and sketching thumbnail ideas.

The more ideas sketched the better. Sketch overall designs and also individual parts such as fins, tails, stabilizers and other parts. Evaluate and select your best designs, sometimes combining ideas to get the perfect blend.

4. Draw up a set of plans including a technical drawing - full scale - so you can use it for patterns. A material list and steps complete a set of plans.

5. Construct your project following basic procedures of:

a. layout
b. cut
c. shape
d. assemble
e. finish sand & paint

**Pay close attention to details assuring high craftsmanship and quality work.*

6. Test you solution and log results.

Flight projects should be tested in the wind chamber and on the balance beam first. Balance your model on the balance beam and turn on the fan forcing air over your model, the model should stabilize itself and face into the wind. Some models can be flight tested in the hall, gym or outside, see your teacher for proper procedures.

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Student worksheets

Following are worksheets to be completed by the student while performing workstation activities

Problem Solving Process worksheets

Defining the Problem

Gathering Information

Developing Solutions

Evaluation & Selection of Ideas

Technical Drawing

Planning Sheet

Machine / Tool Use

Testing

Evaluation

Defining the Problem

1. What station do you want to work at?

2. List two different possible projects you could do at this station.

_____ _____

3. What Project(s) do you want to work on?

A. I am going to design and make -

B. The purpose of this project is to -

4. What criteria or specifications apply to your activity?

A. Who is going to work on this project?

B. How long will it take or how long do you have to work on this project?

C. What are the size limitations?

D. What equipment, tools, and machines will you use?

E. What materials will you need?

F. How will you evaluate your project or what factors will consider it a success?

G. Draw a time line of your project work on back.

5. What books, magazines, or other resources can you use to gather information on your project/

6. Brainstorm possible solutions on back.

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Gathering Information

Complete this worksheet and hand into teacher for approval

1. List and describe the two types of research:

2. Make a list of what you already know about your topic:

a.

b.

c.

d.

3. Define 12 vocabulary words related to your project from your vocabulary list: *(On another sheet of paper)*

4. Sketch 5 ideas as they relate to the vocabulary list. *(On another sheet of paper)*

5. Draw a historical timeline showing the evolution of your topic or station.

6. In paragraph form describe the important concepts as they relate to your topic.

Developing Solutions

Generating a number of solutions is one of the most important steps and often the most difficult to do. Ideas can be generatedthrough writing down ideas or sketching them out. Different problems will lead to different approaches. You can write out a list of your ideas explaining the details or you can sketch ideas explaining your solutions pictorally. In producing many different solutions it is important not to judge or evaluate ideas at first as this may restrict your creative flow. Some basic rules for brinstrming ideas are:

A. THINK FIRST - JUDGE LATER
B. THE WILDER THE IDEA THE BETTER
C. QUANTITY IS WANTED
D. COMBINE IMPROVE AND EXPAND IDEAS
E. TAKE SHORT BREAKS WHEN STUCK
F. WORK IN GROUPS

The step of sketching ideas is called THUMBNAILS. A thumbnail sketch is a simple drawing that you use to help get your ideas on paper. I doesn't need to have a lot of detail or definition. Keep your thumbnails simple and small.

Use the space below to sketch your different ideas, add notations to explain the different parts and detail.

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Evaluation And Selection of Ideas

Complete Worksheet and hand in for teachers approval

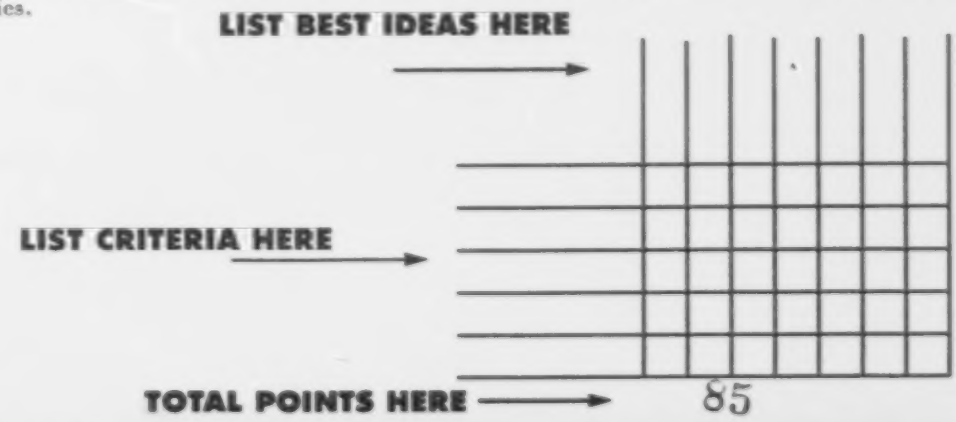
The amount of ideas you can develop are massive. What is needed is a way to discriminate and converge on the most workable and potentially rewarding ideas. It is suggested, as an idea-sorting device, that you simply apply numerical ratings of importance to the ideas brainstormed. A scale such as this would work effectively: 3 points = good; 2 points = fair; 1 point = poor. The emphasis here is to converge the many ideas into a more workable listing of fewer ideas.

The next step is to select criteria by which the ideas favored may be applied. It is suggested that criteria should include anywhere between five to six items. Some criteria which might be considered would include the following:

ease of doing
cost
safety
works consistently
quality of design
durable
attractive
school policies
construction time
set up time
suits problem
available parts and material
enjoyable
useful

The four or five criteria should be written on a grid. These items are chosen on abasis of appropriateness to the problem or project possibility.
The best ideas sorted are then written on top spaces of the grid.
Starting with the first criterion item, judge each idea across the page. Award points to each idea. Use the point distribution reccommended by the rating scale.

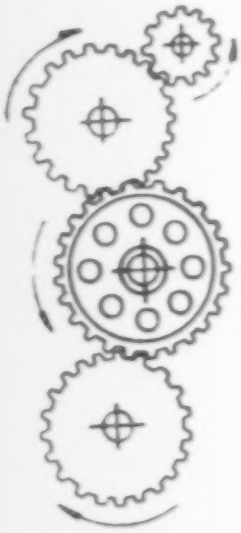
Proceed through the evaluation grid by moving to the second criterion. Award points accordingly with each criterion until the selected ideas have been evaluated. Total the number under each column at the bottom of the grid. Ideas receiving the greatest number of points would be considered promising project solution possibilities.

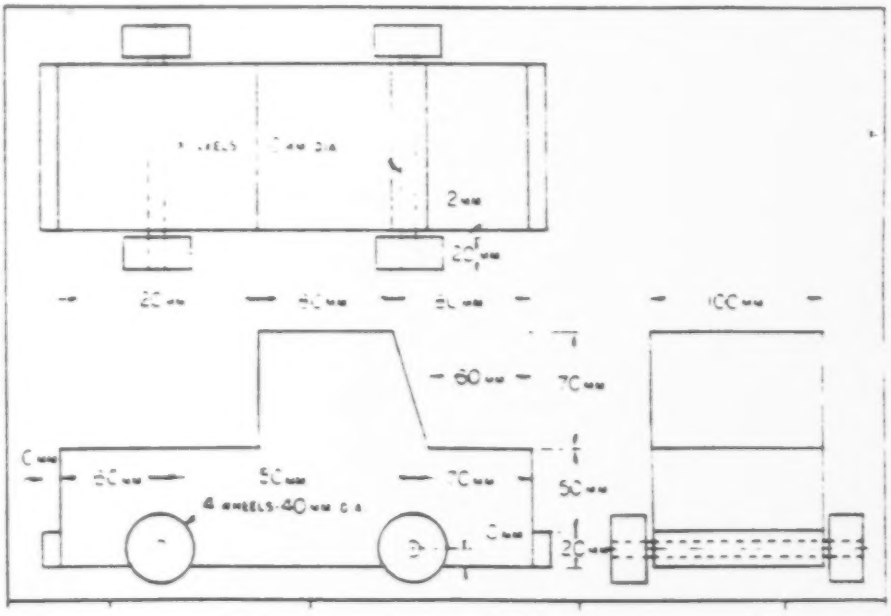


Technical Design & Illustration

The purpose of this step is to correctly use the standard lines, symbols, figures and notes in making working drawings

If a drawing is to serve its intended use, it must not only show the shape of the objects, but in addition, it must contain information as to sizes of the pieces, kinds of materials to be used, the number of parts required, and such other essentiall data as may beneeded to construct the object. In addition, the drawing must furnish the worker with information on the distance between surfaces, location of holes, kind of finish, type of material, number required, etc. The expression of this information on a drawing by the use of lines, symbols, figures and notes is known as dimensioning.





INFORMATION:

The principles of orthographic projection are:

1. The front and side views are in line horizontally.
2. The front and top views are in line vertically
3. The front of the object in the top view faces the front view
4. The depth of the top view is the same as the depth of the side.
5. The width of the top is the same as the width of the front view.

YOU MUST COMPLETE A TECHNICAL DRAWING OF YOUR DESIGN.
Follow the instructions from this sheet and complete your drawing on a piece of graph paper

Planning Sheet

Name_____

Nme of Project _____ Date Started_____

Bill of Materials

Qty. Needed	Size T W L	Name of Part	Material

Procedure of Steps

_____

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Tool And Machines

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Machine / Tool Use

Complete this worksheet and return to teacher for Approval

List five (5) general safety rules for all machines in the technology lab.

_____

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_____

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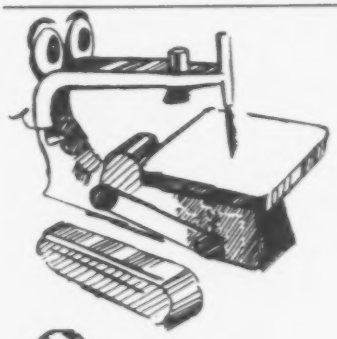

Name _____

Use and Safety

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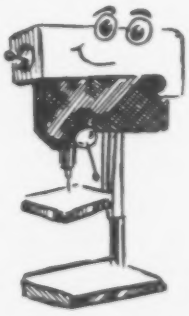

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PROBLEM SOLVING with WORKSTATIONS

Name_____ Date_____ Project_____

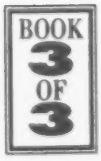
The following is a checklist for you to evaluate yourself as to how well you accomplished each step of the design / problem solving process. This checklist can also be used to evaluate your documantation.

DESIGN / PROBLEM SOLVING PROCESS EVALUATION		POINTS EARNED STUDENT	POINTS EARNED TEACHER
Define th Problem (10 pts)			
A. No design brief or specifications.	0		
B. Brief included, no specifications	5		
C. Brief and specifications included.	10		
Gathering Information (20 pts)			
A. No evidence of research.	0		
B. Some research but lacking depth.	10		
C. Evidence of thorough research with references 20	20		
Developing Solutions (10 pts.)			
A. Only one solution considered.	0		
B. Three solutions generated but lacking clarity of idea	5		
C. Six possible solutions generated with clear descriptions	10		
Selection of Solutions(10 pts.)			
A. No selection process shown.	0		
B. Selection process shown but criteria unclear.	5		
C. Selection process shown with criteria clear.	10		
Planning (10 pts.)			
A. No plans developed	0		
B. Partial plans completed	5		
C. Complete plans with attention to details	10		
Making or Developing Solution (10 pts.)			
A. Solution not completed.	0		
B. Solution functional but incomplete	5		
C. Solution Completely developed with quality	10		
Testing (10 pts.) (If applicable)			
A. Solution not tested	0		
B. Solution tested with weak presentation of results	5		
C. Solution tested with good presentation results	10		
Evaluation (10)			
A. No evaluation written.	0		
B. Evaluation written with very little insight and self-criticism.	5		
C. Good evaluation including success and needed alterations	10		
Overall Presentation (10)			
A. No presentation or documentation of work	0		
B. Limited presentation of work, not neat or organized	5		
C. Good presentation of work, neat and organized.	10		
TOTALS	89	**100**	

Work Station Evaluation

You need to complete a self evaluation of your workstation project. This evaluation will be used to figure out your grade. Hand in the self evaluation as part of the Design Portfolio. Try to honestly state what grade you deserve and explain why you deserve that grade. Categories and their details are listed for your convenience. Answer questions yes or no.

Criteria: **Were the criteria or specifications set forth in the Design Brief met for your project**	Student	Teacher
1. Were time line deadlines met, with all finished work handed in on time? 2. Was project made with allotted materials? 3. Did the project meet its purpose as set in the Design Brief? 4. Is the project the best solution to the problem? 5. Was the project made within the size limits? 6. Are all components of the solution completed? 7. Is safety planned into the solution?		
Creativity: **Were many ideas considered and creative solutions explored**		
1. Is the solution a unique, original, one of a kind project? 2. Are the materials used in a new or different way, adding to the whole project? 3. Was the solution assembled in a unique and original fashion? 4. Was the solution finished off, or is it in a rough stage?		
Craftsmanship: **Was appropriate time taken and proper techniques used to ensure the best quality as possible in the final solution**		
1. Are all processing marks removed, scratches, dents, layout and rough edges? 2. Assemble of project is completed in a neat manner? 3. Measurements of assembly is correct so all parts fit perfect? 4. Solution has good design elements incorporated so it looks neat and attractive. 5. All parts are in place firmly with no loose ends?		
Complexity: **Does the creation demonstrate thorough planning resulting in a solution of complexity and thoroughness for time allotted.**		
1. Solution has many parts or processes accomplished during production? 2. Solution accomplished with very little help or teachers assistance? 90		



All artwork, (design, typesetting &
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